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DEPARTMENT OF AGRICULTURE.

MISCELLANEOUS. SPECIAL REPORT No. 2.

PROCEEDINGS

OF A

CONVENTION OF AGRICULTURISTS

HELD AT

THE DEPARTMENT OF AGRICULTURE,

January 23, 24, 25, 26, 27, and 29, 1883.

(SECOND CONVENTION.)

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PROCEEDINGS OF THE CONVENTION.

FIRST DAY.

TUESDAY, *January* 23, 1883.

In November, 1882, the Commissioner of Agriculture issued the following invitation to representatives of the various branches of agriculture throughout the country:

UNITED STATES DEPARTMENT OF AGRICULTURE,
Washington, D. C., November 17, 1882.

SIR: It is my desire to call together in convention, to be held in this Department during the coming winter, representatives of the various agricultural colleges and associations in this country for conference and discussion. I wish to meet those who are interested in the animal industry; those having charge of the agricultural colleges, agricultural societies, and the educational agricultural institutions of the country; and those engaged in the culture of cotton, for the purpose of considering the general welfare of agriculture and the various divisions of the industry to which I have alluded.

I shall feel under great obligations to your college or association if it will send representatives to these conventions who are qualified to take part in the proposed deliberations.

The first of this series of conventions will be held on Tuesday, January 23, 1883, and will be devoted to the colleges and agricultural societies for the discussion of the general principles of farming, and of those questions which belong to agricultural education and the organization of schools, colleges, and associations, and will continue two days.

The second of the series will meet Thursday, the 25th of January, and will be devoted to the discussion of the animal industries of the country, and the various modes of breeding, feeding, and dealing in horses, cattle, sheep, and swine. This convention will continue two days.

The third of these conventions will be held on Monday, January 29, and will be devoted to the discussion of the cotton crop, its cultivation, sale, and relation to agriculture in the cotton States, and will continue two days.

I would request your college or association to send representatives to as many of these conventions as possible.

Will you be kind enough to designate some officer or representative of your college or society who will be willing to read a paper before the convention which he is elected to attend, and notify me of your selection? Please send to this Department a list of the representatives as soon as chosen.

For the guidance of those who will take part in these conventions I would suggest the following topics for discussion and written essays. To those representing the agricultural colleges and societies I would refer:

1. Standard of admission to colleges.
2. Manual labor as part of a system of education.
3. The demand for educated technologists and specialists in the practical affairs of the industries of our country, and the best methods of educating them for agricultural and other industrial work.
4. The necessity for agricultural education.
5. Literary culture as an accompaniment of scientific training.

To those representing the animal industries I would refer:

6. The breed, shape, size, and temper of the horse best adapted to the United States.
7. The breeding and feeding of beef, and the supply of the market therewith.
8. Sheep best adapted to American agriculture, and the profit of wool-growing in various sections of the country.
9. Swine best adapted to Western farms and the market.

10. The question of an American representative to the international exhibition of animals at Hamburg, in July, 1883, which has been referred to this Department, will be discussed.

11. The transportation of cattle to home and foreign markets.

To those representing the cotton industry I would refer:

All questions affecting the general interests of the industry.

Very respectfully yours, &c.,

GEO. B. LORING,
Commissioner of Agriculture

In compliance with the foregoing circular, accredited delegates from the several organizations represented met in the library room of the Department of Agriculture on Tuesday, the 23d of January, 1883, and at 10 o'clock and 20 minutes, were called to order by Hon. George B. Loring, Commissioner of Agriculture.

Commissioner LORING said:

GENTLEMEN: I have called this Convention in accordance with what I hope is now an established custom of the Department, in order that I might ascertain, so far as possible, the views, feelings and experiences of those sitting outside the Department and witnessing the work it is endeavoring to carry on. The two Conventions which have preceded this were productive of great good. The first Convention, which was called by one of the most distinguished of my predecessors, opened the way, by the frank and free discussion of the relations existing between agricultural education and practical farming, in such manner that the attention of the country was arrested, and this discussion has been going on actively and vigorously from that time.

The Convention which met here last year followed up, with additional experience and information, the views expressed in the former meeting in such a way, that the interest of the country was still more strongly directed to the necessity of combining scientific and practical information in the matter of developing all the agricultural interests of this Republic.

I have been encouraged, therefore, to call this Convention here at this time, feeling that the steps already taken may be continued with profit, and knowing, from the observation I made quite largely last year, that not only the farmers themselves had become interested in this union which I have been endeavoring to bring about, but the colleges were becoming more and more warmly enlisted in it, and that they were appreciating the necessity of standing by the practical business of farming with renewed energy and zeal. It seems to me that this union is becoming complete, and I must say, considering the difficulties that surround us in all the agricultural endeavors of this country, I feel compelled to congratulate the country, the farmers and the students alike, upon the fact that the real capacity of American agriculture and the real methods of conducting it, have at last become thoroughly understood; and hereafter the student and the farmer will go hand in hand in those investigations which, I am sure, will make American agriculture what it should be—the inheritance and the foundation of the prosperity of a free, thoughtful and intelligent people, occupying a great variety of latitudes, and engaged in the cultivation of almost every crop known to man, from the northern to the southern sections of the world. [Applause.]

I have found it necessary, in conducting the work of the Department during the past year, to invoke a great deal of outside assistance, and

it is in this spirit also that I have been induced to call this Convention, feeling that the business of conducting, controlling and guiding the agriculture of this country could not be confined here at the Department, within the four walls of the building which it occupies. I know of no question worthy of investigation, gentlemen, which can be settled on this spot. The business of wheat-growing in all its varieties and localities, cannot be regulated from this point; the best methods of breeding, managing and disposing of cattle cannot be determined here, nor can the causes of and remedies for the diseases to which they are subject, be settled by a veterinary surgeon stationed in Washington. I have come to the conclusion that the Department must of necessity solicit outside aid for the investigation of all those questions which, under its organic law, it is required to ascertain and report upon. I have endeavored, therefore, to extend the work and usefulness of the Department by employing in various States of this Union, competent agents to inquire into and report upon those questions of interest to the farmers of the country. I have felt that the farmers west of the Mississippi River should understand exactly what are their best methods, and that trustworthy persons should be employed to report upon the condition of agriculture in that section; and I have instituted an investigation there by experts who understand their work thoroughly and well. You already know that an attempt has been made to define the necessities of certain sections of the country in regard to the importance and the best methods of preserving and increasing our forests. The gravity of this subject is recognized everywhere, not only in this country but in all others. In the older countries of Europe it has become a matter of scientific investigation, and so much a matter of governmental necessity, that some of their most important departments are devoted to the care, improvement and propagation of timber growth. We have had laid before us here from time to time, in a most elaborate way, all the acts passed by other Governments for the protection of forests. We have also before us in a scientific way, descriptions of every variety of tree grown in the world of value for timber purposes, lumber, &c., and we have learned of different measures which some of the States have adopted for the protection and increase of their forest growth. I have felt the necessity of ascertaining through actual personal investigation, the condition of the growth of forests upon those lands already stripped by the settler, by the lumberman or by fire. In order to accomplish this, I have called into the service of the Department a skilled investigator, one of the most intelligent, active, and vigorous men of the West, whose report written upon the Paris Exposition with regard to experiments in forestry, attracted so much attention that I felt authorized to employ him for the purpose to which I have alluded. He has investigated the forestry growth of Kansas, Nebraska and some of the Territories northwest of those two States, and laid before me certain facts of actual practical interest to the country. Knowing, as he does, exactly what can be grown on those lands; understanding the laws under which these trees can be grown, and having ascertained by personal investigation what the condition and quantity of standing timber now is, his report cannot fail to be exceedingly useful to the country. It does seem to me, therefore, that investigation of this description is of great importance and that, while the views of foresters well known the world over, relative to the forestry growth of America and the legislation of foreign countries on the subject, are brought to us here, it is of prime importance that the keenest, most active intelligence should be employed in our own localities for the solu-

tion of our own questions. And when you remember, gentlemen, that the forestry growth has assumed this remarkable—the most remarkable attitude, and an importance beyond any crop grown on our land, I think you will realize the value of what has been accomplished in this direction.

We have reached a point where the great pine forests of the North are becoming destroyed, in Minnesota and Wisconsin and the great Northwestern borders, at a rate which in ten years will remove most of the soft wood of those regions. Meanwhile, the vast pine forests of the South stand waiting for some active industry to take possession of them. At the rate the pine forests of Texas are now being cut down, there is pine timber enough to last two hundred and fifty years. In Georgia, it will last one hundred years at the present rate of consumption; in Mississippi seventy-five years, and so on; and therefore there is no immediate concern here, where there is so large a belt which has not yet been occupied by the lumberman for profit or the settler for habitation. Now it is suggested, considering the fact that where these forests are being cut at the North nature is restoring them with great rapidity, it will be worth while for us to consider the possibility of supplying ourselves with pine lumber from the South, and giving the northern growth a fair chance. Were you to visit the State of Maine you would find it full of young, vigorous growth of spruce and pine trees which represent more money value than the growth which preceded it, for the reason that the smaller lumber now is vastly more valuable than the larger lumber was then. So far as lumbering is concerned, I remember perfectly well a piece of pine land purchased in the State of Massachusetts by an old settler, who bought nothing but lands from which the timber had been removed, and in fifty years it was found that there had been more money made upon those pine lands, purchased at the prices at which they were sold at that time, than on land purchased on State street, Boston, which is analogous to Wall street, New York, the great business mart of our country. I state facts in order to show how imperatively necessary it is to go outside of the Department to obtain that information which is only developed by strong, vigorous, personal observation and application, and in all such work, I desire to say to every gentleman in this hall, whether it be applied to forestry or to crops, or to any investigation within the scope of the Department, I am in thorough and warm sympathy, and shall be so as long as I have the honor to fill its executive chair. [Applause.]

The same principle applies to our animal products. How can I ascertain here what is for the benefit of those great herds of cattle, large number of horses, of swine and of sheep, that are not only exposed to the trials of climate, but also to animal diseases? And so I have taken pains to send into the localities in which these diseases exist competent persons to make proper investigation, and I am sure the information obtained from such sources will be found vastly more valuable than anything that can be derived from different theories, drawn from the imagination perhaps, for the guidance of the farmer in his work. You all know that there is no one animal among the varieties of cattle suited to every latitude. At the extreme North, we have found that while the Short-horn breed lies at the foundation, the ingrafting of a little hardier, more compact, solid form, and perhaps active blood, is always of benefit to that section. So in the Northwest, the ingrafting of the Hereford upon the Short-horn is thought to be of great advantage, and I think the breeders are right about it. Go further South, and no

one ever desires so far as I can learn, to dispossess the Short-horn. I have seen herds of grade Short horns driven into the fair-grounds in Indiana, Kentucky and Kansas that could compete with anything I have ever seen in England. Take the Jersey; while it can be grown with a certain degree of prosperity even here, its paradise is in the milder sections of this country, and there is no spot on earth which produces that valuable animal so advantageously as the medium latitudes extending from the middle of Ohio, Indiana and Illinois southward to the Gulf. There are good Jerseys, it is true, in other sections, but their paradise is unquestionably in the milder latitudes. Now, as to the western plains, some one must ascertain the most valuable animal for those great prairies which lie open to the hand of man and only ask for occupation. In order to observe this and other questions, we find that investigations must be made by intelligent persons in the particular locality, because the law which governs breeding, feeding and caring for cattle in New England does not apply to Kansas. I have endeavored, therefore, to ascertain all facts bearing upon this branch of agricultural industry through careful investigation.

We all know there are certain latitudes in our country not especially adapted to the universal growth of the corn crop, while there are others particularly suited to that growth; and that there is a great corn belt just exactly as there is a great wheat belt. I think it is important that these herds and fields should be investigated and examined by those who know precisely what are the local necessities, and who thoroughly understand what has and what has not been done.

So, too, with the question which is attracting so much attention now—the production of sugar from sorghum. Why, the most enthusiastic advocate of the production of sugar from this source, would hardly assert that there is a universal law applicable alike to the northeast corner of the State of Maine and the southwest corner of the State of Kansas, by which sorghum accommodates itself to all circumstances and conditions. I asked Professor Weber, at Saint Louis, the other day, why it was that Professor Goessman, of Massachusetts, one of the best of our chemists, found sorghum sugar-making impracticable, and his reply, written in my note book, was, "Because the season in Massachusetts is too short, the frosts are too early and the plant does not mature there." Now, Professor Goessman found that to be the fact in Massachusetts. Professor Cook finds an entirely different fact with regard to New Jersey, and Professor Wiley another respecting Indiana. You cannot, sitting here under this roof, ascertain a law which is applicable to that or any other plant from one end of this country to the other. I have, therefore, referred the practical part of this question to experts, to report the facts as they find them. This is the kind of information I have endeavored to secure on this question. I know perfectly well that the manufacture of sugar from this plant must inevitably vary according to climatic conditions, and I have called upon the sorghum-sugar manufacturers, from one end of the country to the other, to report to me their best methods and their best processes and results. While it may fail in Washington, it may prove profitable in New Jersey, and failing in Massachusetts, grow to perfection in Illinois and Kansas. In all these questions, therefore, I have endeavored to avail myself of this local information, and I am sure you will all realize their importance and stand ready to join hands with me in such investigations.

With the statements I have made in reference to my efforts in this direction and with the assurance of my sympathies on all these questions, I am confident no well-founded criticism can be interposed against me

as a person indifferent to any branch of agricultural industry out of which the farmer or manufacturer can make his living. I have no feeling save the desire that every industry shall be developed to the highest point of agricultural prosperity, knowing as I do that upon this prosperity depends the very existence of our institutions, the comfort and support of more than twelve and a half million farmers of this land; of more than fifty thousand farmers in my own State of Massachusetts; of more than ninety-six thousand in the State of South Carolina, and of more than Heaven knows how many in Ohio and the great Northwest—the people who hold in their hands the power and grandeur of this Republic, from North to South, from East to West. [Applause.] This has been my object in seeking outside observation and work, and I trust I shall be able to lay the information from these sources before the country rapidly, in order that the farmers may, through the instrumentality of the Department which they themselves have founded, enjoy ready access to that collected in another.

I congratulate you, gentlemen, upon the liberal representation we have here this morning, and upon the still larger representation that we are promised as the Convention progresses. I congratulate myself upon this renewed assurance that the interest in these annual Conventions has not lessened, and I trust this interest will continue and that the meetings held in this Department will rank among the most energetic and influential assemblages of this country.

I will now lay before you the papers which have been presented for discussion, and then call for a temporary organization and the formation of such committees as will be necessary in order that the work may proceed. The papers to be read to-day are "The Manual Labor System," by President Abbott, of Michigan; "The Necessity for Agricultural Education," by Augustine J. Smith, of Maryland, and "The Relations of Science to the Industries and Arts," by Professor Wiley, of Lafayette, Ind.

In order that you may understand exactly how many delegates are to be present, I will read a list of those thus far accredited to the Convention.

The list was thereupon read, and at its conclusion the following colloquies ensued:

Mr. COOK, of New Jersey. I wish to say that I feel authorized to state that Mr. Dudley, who is to represent the New Jersey Experimental Station, is to be present. His name is not on the list.

The CHAIRMAN. The name will be entered.

The receipt of the credentials of H. B. Moulton, G. F. Needham, Milton Ford, Dr. E. P. Howland, and William H. Chase, as delegates to represent the Potomac Fruit Growers' Association of the District of Columbia, was then announced.

Mr. GRINNELL, of Iowa. I was not aware that I was honored with an appointment from my State. I find the State represented by the State Board of Agriculture, which has sent the Hon. Mr. Coffin, and the State College by Prof. Knapp.

The chairman also announced the credentials of Prof. Wm. H. Seaman, as proxy for Mr. C. E. Vawter, to represent the Miller Manual Labor School, of Virginia;

Also the credentials of Hon. R. M. Wolf, to represent the Indian International Agricultural Society of the Indian Territory;

Also the credentials of Hon. R. B. Ross, to represent the above society;

Also the credentials of Prof. John R. Page, to represent the Virginia State Agricultural Society;

Also the credentials of Thomas N. Conrad, to represent the above society;

Also the credentials of Benjamin S. Warner, to represent the Board of Agriculture of Connecticut.

The list of accredited delegates to the Convention was then completed as follows:

ALABAMA.—*At Large:* W. T. Webb, W. Leroy Brown.

CALIFORNIA.—*University of California:* Hon. A. L. Rhodes, Hon. C. P. Berry.

CONNECTICUT.—*Board of Agriculture:* Prof. W. H. Brewer, Benj. Warner, T. S. Gold, J. Leroy Buck. *New England Tobacco-Growers:* S. G. Hubbard.

DELAWARE.—*Delaware College:* Professor Wesley Webb, Prof. W. H. Purnell.

DISTRICT OF COLUMBIA.—*Fruit-Growers' Association:* H. B. Moulton, G. F. Needham, Milton Ford, E. P. Howland, Wm. H. Chase.

ILLINOIS.—*Illinois University:* Prof. S. H. Peabody. *Illinois Dairymen's Association:* H. B. Gurler, C. C. Buel, R. P. McGlincey. *At Large:* Ezra Stetson, J. H. Sanders. *State Agricultural Society:* Hon. Geo. S. Haskell, Hon. H. G. Savage, Hon. Samuel Dysart.

INDIANA.—*State (Ind.) College:* Prof. H. W. Wiley. *Northeastern Agricultural Society:* Hon. W. S. Holman. *State Board of Agriculture:* Robert Mitchell, R. U. Lockhart, Alex. Heron, J. B. Conner.

INDIAN TERRITORY.—*Indian International Agricultural Society and Fair Association:* J. A. Foreman, Hon. R. M. Wolf, R. B. Ross.

IOWA.—*Stock Breeders' Association:* John Scott. *State Board of Agriculture:* L. S. Coffin. *State Agricultural College:* Prof. S. A. Knapp. *Iowa State Agricultural Society:* Hon. James Wilson, Col. John Scott, L. S. Coffin. *At Large:* Hon. J. B. Grinnell.

KANSAS.—*At Large:* F. P. Baker.

LOUISIANA.—*Bureau of Agriculture:* W. W. Pugh.

MAINE.—*Agricultural College:* Prof. A. B. Aubert.

MARYLAND.—*Agricultural College:* Wm. P. Headden, Allen Dodge, J. D. Warfield. *At Large:* Augustine J. Smith, W. W. W. Bowie. *The Grange:* General E. L. F. Hardcastle, Hon. W. T. P. Turpin, Henry M. Murray, Col. William Allan, Edward Austen, William B. Sands. *Maryland Improved Live Stock Breeders' Association:* Alexander M. Fulford.

MASSACHUSETTS.—*Board of Agriculture:* O. B. Hadwen. *Franklin Harvest Club:* Jas. S. Grinnell. *New England Tobacco-Growers' Association:* S. G. Hubbard. *Agricultural College:* Jas. S. Grinnell. *Essex Agricultural Society:* Ben Perley Poore.

MICHIGAN.—*Agricultural College:* Prof. T. C. Abbott.

MINNESOTA.—*University of Minnesota:* Prof. W. W. Folwell. *At Large:* Dr. C. W. Ballard.

MISSISSIPPI.—*Cotton-Planters' Association:* T. C. Morehead.

NEBRASKA.—*At Large:* Hon. R. W. Furnas. *State Agricultural Society:* Hon. Edward McIntyre.

NEW JERSEY.—*State College:* Prof. Geo. H. Cook. *State Agricultural Society:* Thomas H. Dudley.

NEW YORK.—*Cornell University:* Prof. James Law. *Sheep Breeders' Association:* Wm. G. Markham. *At Large:* T. D. Curtis. *At Large:* F. D. Curtis. *State Agricultural Society:* Gen. N. M. Curtis, H. E. Alvord, G. S. Miller.

NORTH CAROLINA.—*University of North Carolina:* Prof. Jos. A. Holmes.

OHIO.—*Board of Agriculture:* R. Baker, L. B. Harris, C. D. Bailey, J. C. Lovering.

PENNSYLVANIA.—*State College:* Geo. W. Atherton. *At Large:* Johnson Miller. *Board of Agriculture:* Geo. Blight, L. H. Twaddell.

RHODE ISLAND.—Hon. Jonathan Chace, J. Erastus Lester, Hon. Rowland Hazard, C. W. Smith.

SOUTH CAROLINA.—Maj. H. Hammond.

TENNESSEE.—*At large:* Col. B. F. Cockrell.

TEXAS.—*Agricultural Association:* Elk Johnson, E. M. Johnson, J. D. Morrison, W. W. Lawton.

UTAH TERRITORY.—Hon. George Q. Cannon.

VERMONT.—*State Agricultural Society:* Hon. W. W. Grout, Hon. Justin S. Morrill.

VIRGINIA.—*Agricultural Institute:* C. Armstrong. *State Agricultural Society:* Thos. M. Conrad, Dr. John R. Page, Prof. M. P. Scott, Richard V. Gaines, Col. Robert Beverly, Dr. M. G. Ellzey, Geo. W. Palmer, Wm. A. Stuart, J. Ravencraft Jones, E. B. Goode, Col. S. S. Bradford. *Manual Labor School:* Wm. H. Seaman. *Piedmont Agricultural Society:* S. S. Bradford. *Agricultural and Mechanical College:* Prof. Thomas M. Conrad, Prof. M. P. Scott.

WEST VIRGINIA.—*West Virginia University:* Logan Osburn.

WISCONSIN.—*State Agricultural Society:* Hon. J. H. Warren, Geo. E. Bryant, Clinton Babbitt.

THE NATIONAL GRANGE.—Hon. D. W. Aiken, Henry O. Devries.

UNITED STATES AGRICULTURAL SOCIETY.—J. A. King.

NEW ENGLAND AGRICULTURAL SOCIETY.—O. B. Hadwen, Jas. S. Grinnell.

The CHAIRMAN. The chair would suggest that a temporary organization be now made.

Mr. GRINNELL, of Massachusetts. I nominate Mr. Abbott as temporary president.

The nomination was seconded.

Mr. ABBOTT. Mr. Chairman, I have great difficulty in seeing and recollecting countenances, and I think, therefore, I had better be excused.

The CHAIRMAN. I would say to Dr. Abbott that the work will be very short, as it simply consists in the appointment of a committee to retire and report a permanent organization.

Dr. Abbott was then elected and occupied the chair.

Dr. ABBOTT. I thank you, gentlemen, for the compliment of this temporary office, and without further remarks we will now proceed to such business as may be in hand. What is your pleasure?

Commissioner LORING. I would suggest, Mr. Chairman, that some one move the appointment of a committee of five to present a permanent organization.

Professor GOLD. I move the appointment of such a committee.

The motion was adopted.

Dr. ABBOTT. How shall this committee be appointed?

A DELEGATE. By the chair.

Dr. ABBOTT. If there is no objection, the chair will appoint the committee. I will appoint Messrs. Gold of Connecticut, Knapp of Iowa, Poore of Massachusetts, Atherton of Pennsylvania, and Cook of New Jersey.

Commissioner LORING. I now move that the committee be instructed

to present such a list of vice-presidents as in their judgment they may see fit, and also a list of secretaries.

The motion was adopted and the committee retired.

Commissioner LORING. We have succeeded, gentlemen, in getting into the chair temporarily, so that he cannot escape us, the author of the first paper set down for this morning, and I move, therefore, that while the committee are preparing their list for permanent organization, President Abbott be requested to read his paper. It will promote the business of the Convention very much indeed to have that done. His paper is upon "Manual Labor as a Part of an Agricultural Education."

The motion was agreed to.

Dr. ABBOTT. I received, some time ago, a marked circular, requesting to be informed upon what topic some delegate of our college or State would prepare an essay, and I immediately indicated my willingness to present a short essay upon the labor system in the Michigan State Agricultural College. I did this, because a year ago the Agricultural College sent two delegates to the Convention called here by Commissioner Loring, and these delegates, upon their return, reported that this question had been under discussion, and that the temper with which the question was met indicated a feeling on the part of some members of that Convention that the Michigan State Agricultural College plumed itself upon the labor system, and that its Faculty seemed to think that all other institutions ought to follow its lead. I have once in a while observed the same spirit in some of the newspapers of the country, when discussing agricultural education, and I must say at the outset that there is no such feeling with us at our college. A college situated as ours is, aside from the idea of a university which narrows its field and in an entirely rural district, having not even a mechanical department associated with it, must have students who can be and very likely would be called upon to have a system different from that which could possibly obtain in such a State as Connecticut, or some of the States where the university system is connected with the agricultural college system. We do not feel this way. We feel that, on the whole, it is a great burden to the professors and the officers in charge. Therefore, with this explanation I desire simply to read to you a short statement of our dealings—of the way we do in the Michigan State Agricultural College. If, at the end, it is found not to be a matter of importance it will be easily over, and if it be worthy of any discussion, will probably open up the points that need to be met. I think I cannot do a better service in this discussion than simply to tell you what we do at our college.

We take the inductive system of simply going to the experience of one old institution of the kind, for it has been a part of our system to pay for services requiring manual labor, three hours a day every day of the week except Saturdays and Sundays, and this has been our custom ever since the college first went into operation in May, 1857. One of the designs of the founders of the Michigan State Agricultural College was to make education cheap to the sons of farmers. The farmers said, "We wish our sons to get an education, but the universities and the colleges are too expensive." They wanted a college to which their sons could go and help pay their own way. This was the prominent idea in the early days of the college. The first president and managers of the institution attempted to so manage, that the farm, the garden, the labor system and the boarding system should be connected so that the student might come there and pay his way by his work. I may as well say at once that this anticipation was not met, and

does not enter into the present system of college management; but, inasmuch as we pay fair wages—8 cents an hour—for work for three hours a day each day except Saturday and Sunday, and Saturday, when called for at the same price, the result has been that a large number of young men come to us for an education and stay their four years, who otherwise never would have thought of coming. They have taken this feature into consideration in their determination to present themselves and pursue a course of studies. A large number of those who come to our college are the sons of farmers in moderate circumstances, and they value this means of helping pay their way. Another result has been the development of pride in self-help. The student who is most frequently seen in society (and in our small city of 9,000 inhabitants our young men find ready access to the best society), is proud of what he does for himself. Those who will be found in the best society there—our nobbiest young men—desire to pay their own way; and those who come from rich farmers, those whose parents are abundantly able to support them, have been there but a short time before they are found trying to see how little they can call for from home and how much they can do for themselves I will not say whether this is good or bad, desirable or undesirable; I state it as a fact that this is the prevailing spirit in the college.

A second reason for the institution of the labor system was the hope that graduates would return to farming. The constitutional provision requiring an agricultural college (1851) permitted it to be made a department of the university. The university stood ready to appoint professors and give the use of its museums and laboratories. It was not quite so large then, but it was growing and prospering under the able leadership of Dr. Chadwin. Now, this principle was rejected by the farmers of Michigan, on the ground that they distrusted it. They said they would never get their sons back at work on the farm. One senator who used to oppose us, and who has a son now in the junior class, said there would not be three per cent. returned there. "Why," he said, "my district is full of university graduates, and hardly one of them will work." Now, I will not say whether it is right to try to forestall the student's wishes or hopes to halt drive him from agricultural pursuits by putting him off where he would have to work and live a life away from the other departments; but whether rightly or wrongly, that is the way in which some of our Michigan men looked at it. If any one wishes to know whether or not our experiments in educating young men have proved successful, I refer them to our State Agricultural College, and to all our associations that measure us in a great degree by the number of graduates we return to the farm, and their standing among the farmers of their vicinity. Now the influence of this and some other things that we do, returns a much larger proportion of our graduates to the farm than we ourselves anticipated.

Some years ago I made as careful an examination as I could of the occupation of college graduates West as well as East; I found less than one in one hundred and fifty engaged in agriculture. The University of Michigan has sent nearly $2\frac{1}{5}$ per cent. of her graduates either to farming, or to farming together with medicine, law, or some other calling.

The Alumni Association of the Michigan State Agricultural College reported that in August, 1881, there were two hundred and thirty living graduates, of whom ninety-three were farmers, six horticulturists, three fruit culturists, sixteen professors, and teachers of agriculture or related sciences, two apiarists, two agricultural editors, two in the

United States Signal Service, one veterinary surgeon and seven engineers.

Those of our graduates who are on farms stand well among farmers, and take an active part in their societies.

This fact, I believe, has had more to do than any other one circumstance in winning for the college the warm support which it receives from the State Agricultural Society, the State Horticultural Society and the State Grange.

Another use of the labor system is to furnish the beginning of practical skill in farming and horticultural operations. The students built our sheep barn and horse barn in good part, and our piggery entirely; they assist in the care of cattle, do all repairs to steam works, paint, manage the bees, do the most of the farm and garden work, keep books, and so on. The extent of these labors vastly exceeds what an ordinary farm would furnish.

As the farmers of the State become richer, this feature of the labor system is coming into greater prominence. The sophomores work their entire year on the farm, so that they may see and be interested in farm work and management for a continuous year. For a similar reason the juniors do all their work for their year in the horticultural department. We hope by associating really hard work with a knowledge of science and a spirit of investigation, to relieve it of its character as drudgery.

A graduate of last August said to me, "For a year or two after I came to the college I thought it impossible that I should be a farmer. I had had enough of it before I came." He now prefers that calling to any other, and is a farmer. Another student, when half way through his course, intended to be a physician. He has, as a graduate, become a farmer and delights in his business.

Students work well. It rarely gives me anything but pride to take visitors from place to place to see the work going on. Of course they do not all do their best, and their best is not always very excellent work. But I have often said, and it is true, our students work as well as they study, and their class-room work is highly satisfactory to the officers of the college.

There are difficulties in the way of managing such a work system. It is founded upon no ideals, but necessitates a constant series of compromises between different objects.

It is felt that an agricultural college should furnish a model of every kind of farming. We all know how essential it is that a learner of anything should have models of excellence before him. But too much of our work is done by unskillful hands to permit us to boast of a model farm.

On the other hand, for purposes of practice we should employ students for every kind of labor, but we value an approximation to a model and our property too highly to transfer our blooded stock, our teams and our milch cows from one inexperienced hand to another.

We wish to make the labor of students educational, yet the work must go on; each department is charged with the student's labor which he uses. He has got to show a credit side, and we would like, in this view of the case, to employ students on what they already know how to do—not on what they need to learn. The students, on the other hand, desire to learn while at work, but they are also anxious to get eight cents an hour.

Difficult as we find the management of the labor system, especially the attempts to harmonize the incompatibles, we in Michigan are all believers in it, from the president of our board, the present presiding judge in the Court of Alabama Claims, who has watched over us for the last

twenty-one years as our head, to the least employé of the college. The students believe in it, the State societies pertaining to agriculture believe in it, and the legislatures have never hesitated about granting all the moneys that were asked to support it.

Mr. GRINNELL, of Iowa. Mr. President, upon the suggestion of the Commissioner of Agriculture, I will venture to make a motion, or rather first a suggestion and then a motion. A large number of papers have been solicited and many are prepared, some of them, I presume, are long and right long, and some are short. There are a large number of gentlemen here from whom we should be glad to hear (I know I should), who have not prepared and indeed who have not been invited to read papers. They may not be in the habit of putting their thoughts upon paper. Therefore I move that a business committee of five be appointed, one of whom shall be the Commissioner of Agriculture and another the secretary of this body, which shall prepare the business for these meetings. I make that motion, believing that there will be fair treatment of all who have prepared papers and been invited here. I have attended conventions like this, where the papers were so long and occupied so much time there was no chance for discussion, and where worthy papers, prepared by persons who had come from long distances, were necessarily excluded. I do not, myself, wish to be a member of this committee.

The CHAIR. This is a business committee, as I understand it, which shall look over in advance the papers to be presented at this time, and arrange them for presentation and discussion.

The motion was agreed to.

Mr. DUDLEY, of New Jersey. I move that the chair appoint the committee.

The CHAIR. You place me under difficulty. I have no list, and as I am quite a stranger here, you will do me the kindness to nominate.

Mr. DUDLEY. I should think it would be very satisfactory to the convention if the chair would appoint or select the members of this committee from among those who would serve. Two of them are already designated by the resolution, and I hope the chair will appoint.

Mr. GRINNELL, of Iowa. I venture to suggest Professor Wylie, of Indiana.

The CHAIR. The committee will consist of Commissioner Loring, Mr. Secretary Grinnell, Mr. Coffin, of Iowa; Mr. Whitman, of Maryland; and Mr. Wylie, of Indiana. In the absence of other business, I suppose any paper to be read, or other matter of interest, will be in order.

Commissioner LORING. I have thought that after a paper had been read, it would be a good plan for the members present to discuss it, and to take the papers as they come along—not that the discussion should be long and tedious, but I think the paper just read has certain points in it which delegates present would be glad to discuss. What has been said about the Michigan State Agricultural College I have witnessed myself. I was there last autumn, and observed that the business of farming, as has been stated, is conducted in a systematic and economical way, and that the students themselves manifest a deep interest in what is going on. In the first place, I saw them taking care of the buildings. These buildings were in good order, and their plans excellent. They are such buildings as farmers would erect on their own grounds, and not so elaborate and expensive in construction as would deter farmers from following the good example. They were practical, neat, clean, well-arranged farm buildings, and the

provision made for cattle was as thorough as I have ever seen on any properly managed breeding farm in the country. I think if you should retire, sir, take away every student, and leave the farm to be purchased by some farmer of the West, North, or South, he would find that place as well equipped and in as good condition to work and get a living therefrom as any farm I have seen in this country. I do not mean to say that this is the only one in the country or in the control of colleges worthy of like praise; but I desire to bear my testimony because you, sir, have been kind enough to come here and state the facts for the benefit of this Convention.

There is one point, however, I did not think was dwelt upon sufficiently, and that is, whether manual labor and practical work performed by the students there tend to stimulate their minds to pursue their studies, or to draw them away from their books by the natural influence of hard work, which often operates, as we well know, to dull the faculties. I should like to have Professor Abbott tell the Convention what, in his judgment, is the effect upon the students of the kind of work performed by them while pursuing their studies in the college. That is a very important point, and one that all colleges which have attempted to unite manual labor with education are anxious to discuss and settle.

The CHAIR (Professor ABBOTT). I will endeavor to answer the question propounded by the Commissioner in a general way, for a student's disposition is his own. I cannot find, however, that our three hours of labor a day is calculated to dull the students. They do not think it enough for exercise, and they have their pastimes in foot-ball and other games, as students do in other colleges.

There is, however, as a student passes along in his course, an increasing notion of the value of time, and students who, in the freshman and early part of the sophomore years, would be willing to volunteer their services for any extra job for the compensation, and who would be anxious to find work on Saturday, as they go along in the junior and senior years, are careful of their time. The student becomes more interested in his book, more interested in the calculation and in the literature that the library furnishes; so that he is apt to feel he can give just the required time and no more. This is not, by any means, the universal case. Many value the pay so much that they continue their work after hours, if allowed to do so. But the students themselves who graduate, the seniors, say that there is no lack of interest in their labor.

We sometimes hear it said that the freshmen work the best of all, and I suppose they do in one respect. They come from their homes, they have their three studies, and they push into their work with a great deal of energy. It is a new thing, with new men and new territory; but bye and bye, they begin to work more as a matter of habit. The seniors, however (for I have had occasion to examine three or four classes in regard to it), and those who are the best judges, say there is no lack of energetic work all through the course, and I observe that our professors and overseers always ask for those who have been longest there to do special work that requires care and the confidence of the officers. And this not for one, two or three students, but the whole senior class would be selected, if permitted, where special care, special diligence and real hard work were desired. The seniors who go out, class after class, bear testimony to this as well as those who employ them. This, however, is to be said: there is a growing feeling among our seniors, as they come to the middle of the senior year, that they ought to devote more time to labor which is purely instructive, and little

less, if they could afford it, to that which secures the pay. This is a very frank and fair answer to the question, such as I think even an adversary might give.

Commissioner LORING. You say that the labor is a stimulus to the student; that is, the practical application of what he learns. I think I observed there that the practical application of what the student learns would operate in the various agricultural processes as a stimulus to his studies.

The CHAIR. We frequently see students wandering off to examine for themselves something brought out in the lecture-room, looking after certain crops, &c.

Mr. WARFIELD, of Maryland. May I ask about those three required hours of labor? Is there any break in your schedule, or do you have your recitations in the morning and your work in the afternoon?

The CHAIR. We have the recitations all in the morning and the work comes in the afternoon. The change was made after I became president of the college, about twenty-one years ago. Before I took charge of the college, they had a system of work carried through the day. I was then a professor. I suggested the change that the work should be performed in the afternoon, and I was investigated on account of it. It was said that would be a remodeling of the institution and make it more costly. I appeared before the legislative committee and showed them that, while it was more costly, it was a great deal better for the student, and they unanimously reported I was right.

Mr. WARFIELD. Then do I understand that you have no labor system upon the farm in the morning?

The CHAIR. None, except the chores by the boys, who milk the cows and make the arrangements for that work early.

Mr. WARFIELD. Then, in your classes, numbering fifty or a hundred on the farm at one time, can you so arrange your work as to have them all employed?

The CHAIR. We have been able to, so far. We have a great many improvements going on—building and ditching—a large line of improvements. Our farm is somewhat rough, and we have not found any trouble as yet, except in the early spring weeks commencing in the last of February. We sometimes experience difficulty at that time. We are asking the legislature now for shops for a sort of mechanical department, to teach such work in wood and iron as we think the best farmers would like to know and to have their sons learn; and we shall work them there, if the legislature gives us the means. Both governors have approved it.

A DELEGATE. Have you ever called for volunteers in special kinds of work; for instance, in getting ice?

The CHAIR. We have no trouble in these extra jobs. There are always enough of them who desire the work simply because such jobs take in Saturday.

Mr. WARFIELD. May I ask what mode of marking you would call an absentee from a class of that kind? For instance, you call for volunteers; would you mark him absent?

The CHAIR. I do not suppose that in the last two years any student has been called away from his morning class. If he were called away I should soon hear of it through the officer. They are very particular about absences, and if a student is absent three times he is reported to me and I bring him before our whole faculty.

A DELEGATE. What is the area of your farm?

The CHAIR. Six hundred and seventy-six acres—perhaps a little more.

There is some of it, however, still in woods. Five hundred acres are probably under cultivation one way or another.

The DELEGATE. What is the division between cultivated land and pasturage? I can form a better idea by knowing it approximately.

The CHAIR. We have about 350 acres under cultivation aside from pastures.

The DELEGATE. And about a hundred students usually?

The CHAIR. Yes, we have more than a hundred students. Last term, which was rather thin with us, there were about one hundred and seventy at once.

The DELEGATE. May I further ask the professor whether you classify the work? For instance, are the students given what might be called the easy part of the manual labor, while hired laborers perform the harder parts? Do you require the students to do all kinds of hard work?

The CHAIR. We make no distinction, except that for two years of the horticultural department the professor of horticulture had the right to call each student two afternoons a month to go with him and practice the finer operations in horticulture, and for that labor he received no compensation. That is still on the statute-book, but we have a new professor of horticulture just now. If he chooses he can call the students twice a month to do work under his particular charge, like grafting and whatever else he sees fit to employ them about.

The DELEGATE. Then for hoeing, harrowing, planting, and gathering crops, the students are employed in all that kind of labor, I understand. For instance, in tending cattle, they must be attended to in the morning as well as in the evening; the cows are milked and the pigs fed, for I apprehend you include all that on your farm. Now, do the students perform all that duty?

The CHAIR. The students perform the most of it. We employ a teamster for each team, and we have a regular herdsman; all the help he gets is from students.

A DELEGATE. There is a very important point right here that I would like to draw out. We often hear it said that these agricultural colleges can have but a limited number of students, because it is impossible to have a teacher with them in their experimental work, and that it would be too expensive to have a large school. I would like your idea on that point.

The CHAIR. The oversight of students' work is difficult. Where we employ a gang of three or four or five, and perhaps not more on any job whatever, where what they do can be seen and known, we have no difficulty whatever. Students will go out painting and making repairs. They will go out for anything where it is a set field, and we see the results and have no trouble. Where we send a large number of students together and cannot have an overseer with them, we find difficulty, because we are not able then to distinguish the good workers from the lazy ones. They do not report, and when there are one, two, or three who do no work, but get their pay for it, the effect is demoralizing. It is difficult, and I apprehend can only be perfected by having an overseer. But we have tried, and with good success, the plan of making the seniors overseers. Last term our professor of agriculture met a few of the seniors a little before noon, and made them familiar with the plans of the afternoon and with the list of students to be under the charge of each one, and he acted as an overseer. The students say it worked well. We frequently practice it half the time, and I think more than half the time, finding such a system working well. Students will do

for overseers if seen beforehand, made familiar with the plan and given their list of students.

The DELEGATE. May I ask whether your afternoon details are volunteers, or whether you take the roll and make an alphabetical detail?

The CHAIR. It is compulsory, and they all practice.

THE DELEGATE. The reason I asked, sir, we, of the Virginia Agricultural College, are pursuing your exact plan, having done so thus far this year and it works admirably. The compulsory part—if this is compulsory—we have not yet adopted. Our system is altogether a voluntary one. We have but a three-year course at our college, while yours is four. We take the juniors, who are the first, the intermediates, who are the second, and the seniors, who are the last. We detail the juniors for this lighter work, tending the cows, seeing them cared for, bedded, and milked, caring for the horses, &c., and while ours is called a voluntary system, we have more than we can pay for, and that is our difficulty. We cannot make an appropriation large enough to pay these students for whom we have the work, and I suppose we will have to do as has been suggested, appeal to the legislature for an additional appropriation. I certainly could not take my seat, sir, without thanking you for what you have explained so well to us.

A DELEGATE. May I ask the chairman one more question? Have you ever made a comparison between the expenses of hired labor upon your farm and the amount of expenditure to students? In other words a large list of students labor for pay. Is not the expense very much larger than would be required to have the same amount of work done by ordinary laborers?

The CHAIR. Our professors of agriculture, of whom we have several, think the labor system is expensive. Our legislature, which knows the expense, has never hesitated to meet the cost of it, and never have I known a single member of any legislature to find fault with that item. I do not mean to say that our students do poor work. They do fair work, and if our fields, our crops, our stock and everything we have there, were not fairly well cared for, we should soon hear from it from the State Grange, the State Agricultural Society and the members of the legislature, so that we have to have fair work done, and the students do it.

Commissioner LORING. I merely rise to say that Mr. Kuleshoff, of Russia, is present, who visits this country as a delegate from the Russian department of agriculture, and who was presented to me yesterday by the Russian legation. Mr. Kuleshoff has made a careful and thorough examination of the Department, and is deeply interested in all the questions which will come before this Convention; I move, therefore, that he be invited to take a seat in the Convention.

The motion was agreed to.

Commissioner LORING. I now desire to present a question for a moment's consideration which Mr. Kuleshoff has submitted to me. We shall be obliged to pass on very soon to other matters.

Mr. GRINNELL, of Iowa. Mr. Commissioner, while you are inviting gentlemen to take part with us, I am reminded that a delegate from Utah, Mr. Cannon, is present, and I move he be invited to a seat with us without the form of a credential.

The motion was agreed to.

Commissioner LORING. It seems, Mr. President, that the question is being discussed with regard to practical and experimental farms, as connected with colleges. In Germany, the view is against practical farms and in favor of experimental farms. Now, there is usually this

difficulty. When the students reach the college, they are already generally versed in the practical affairs of the farm, and think, therefore, it is best to step beyond that and take what might be called a scientific agricultural education. The Russians think otherwise, and they unite practice and experiment, as I think we ought in this country. That is my private opinion, however, and I propose to leave the question to you, gentlemen, to decide. The inquiry of Mr. Kuleshoff is: "Do you think it necessary to have an experimental farm in connection with the agricultural college, or simply a practical farm alone, so far as your judgment goes?"

Mr. ATHERTON. Without desiring to interrupt the discussion, I will say that the committee is ready to report a permanent organization. It occurred to me this would be a good time to interpose it.

Commissioner LORING. This discussion will end in a moment.

The CHAIR. The Convention has heard the question proposed by the Russian commissioner through Dr. Loring. Will any member speak upon the question?

Commissioner LORING. I should like to hear, as I am sure the Convention desire, the opinion of the chair on that question.

The CHAIRMAN *pro tempore* (Professor ABBOTT). I have little experience from which to speak. At our college [Michigan] we have intrusted our experiments to the different professors, and have no distinct agricultural experiment station. The last legislature, two years ago (ours meets biennially), requested Dr. Kedzie to make some experiments in sorghum sugar, and appropriated $1,000 for that purpose. They also asked our professor of agriculture to make some experiments in ensilage, and they appropriated $1,000 for that purpose. The board of agriculture frequently requests the others—some member of our faculty—to conduct certain experiments. There is a resolution now in force and the investigation is going on under it, by which Dr. Kedzie, our chemist, was requested to prosecute experiments to ascertain the sources of nitrogen in plants. Throughout, we have committed special experiments to special members of our faculty, and have no separate institution. We have no fields which are devoted to these purposes, as I understand they have in Massachusetts. I have no experience on this point, but I think it is necessary that the agricultural college should be investigating all these questions. Out West they speak of a "live school-master," and it is my opinion you cannot have a live professor who is not investigating, because in these sciences, founded on biology, you are reaching out perpetually into the dark—into what is as yet unknown; and a man—professor of agriculture or what not—unless he is constantly investigating, cannot be the right kind of a professor. This is a notion of mine, but I think it develops a love and animation in a student that is not to be found elsewhere. Our students become investigators. We have a monthly meeting of what is called "The Natural History Society," wherein papers are prepared by the students upon a great variety of topics. They are divided into sections of entomology, geology, and so on. Sometimes they obtain the results they have in view, but however that may be, it encourages a spirit of investigation, a spirit of inquiry into the reason of things. I think a college without that spirit and without the means of enlisting students in this kind of work, would not do all it ought. It strikes me, if there is an experimental station, the college is the place where it should be located.

Mr. COFFIN. I suppose the question very properly submitted by the representative of the department of agriculture of Russia may be answered somewhat by general experience, and while I indorse very

emphatically what our chairman has said, I think we should always impress upon the students the necessity of their making themselves practical farmers. My experience with the young men of Iowa has been that there are few of them who know much about the better methods, to say nothing of the science of agriculture. They do not care so much about the details; they were brought up on a farm. Indeed, some of them have said, "I know all about practical farming"; but as a matter of fact, I have never found young men who knew very much about it. Their knowledge is exceedingly crude respecting methods, aside from those that are exceedingly simple. In fact, few of them would be capable of conducting a farm according to our higher notions of the better methods of agriculture. Hence it seems to me that now and for a great many years to come—I cannot say how many, but through the time of our lives—the necessity to teach the practical farmer the higher order of development will be imperative upon the different institutions of the land. When we have reached the higher methods and instructed the young men how to go out in the world and be practical, I would indorse the idea of investigation, and that the best place for investigation, in so far as its utility is concerned, at least, whether it may be the better place for the investigation in the abstract or not, but so far as it is being taken up and observed by the people, it seems to me is in connection with the agricultural college.

Commissioner LORING. I think the question has been very thoroughly answered, Mr. Chairman, and this answer seems to be that naturally, in this country, the experimental station and practical farming go together. It was exactly so in your college [Michigan]. I saw men visiting Professor Kedzie in the morning, watching his processes and digging stumps in the field in the afternoon. I think this illustrates the easy combination of the two systems of practical farming. Now, unless some gentleman objects, I move that the committee on permanent organization be presented and acted upon.

The chairman of the committee on permanent organization, Mr. Atherton, presented the following report:

President, Hon. George B. Loring.
First vice-president, Hon. L. S. Coffin, of Iowa.
Second vice-president, Hon. Thomas H. Dudley, of New Jersey.
Third vice-president, Dr. John R. Page, of Virginia.
Fourth vice-president, W. W. Pugh, of Louisiana.
Fifth vice-president, T. S. Gold, of Connecticut.
Sixth vice-president, Prof. S. H. Peabody, of Illinois.
Seventh vice-president, Hon. C. P. Berry, of California.
Eighth vice-president, George Blight, of Pennsylvania.
Ninth vice-president, President W. Le Roy Brown, of Alabama.
First secretary, Hon. J. S. Grinnell, of Massachusetts.
Second secretary, Prof. Joseph A. Holmes, of North Carolina.
Third secretary, E. W. Perry, of Illinois.

Mr. ATHERTON. After this report shall be acted upon, I have some recommendations made by the committee, which will come separately.

On motion of Mr. Warfield, of Maryland, the report was agreed to.

Commissioner LORING thereupon assumed the chair and said:

I am much obliged to you, gentlemen, for the compliment, and I desire to say that I shall call upon the vice-presidents as often as I find it necessary to be relieved from the service. What is the next business before the Convention?

Mr. ATHERTON. The committee also took upon themselves the duty of recommending two or three matters for the sake of facilitating business.

Of course it is understood that they are only recommendations, and the committee was very free to state that it was out of their province; but they thought it best to recommend, in the first place, that a committee on the order of business be appointed, to sit from time to time.

The PRESIDENT. Is not that covered by the motion of Mr. Grinnell?

Mr. ATHERTON. I presume that may be so. The second recommendation of the committee is that a committee on resolutions should be appointed, to which resolutions and matters may be referred from time to time. And third, that important subjects which may not be fully disposed of at the present Convention be referred to a suitable special committee, with permission to report at the next annual Convention. That will suggest itself from time to time, and without any special recommendation; but we may expect that some matters that are not fully discussed—matters that are only suggested—will remain to be disposed of at each Convention. There were such at the last Convention, as we remember, and by having a carefully digested statement of the views and the facts which we might otherwise fail to secure, we shall better promote the objects of the Convention.

The PRESIDENT. The first proposition of the committee is a further suggestion that a committee on resolutions be appointed.

The recommendation was submitted to a vote and agreed to.

The PRESIDENT. Of how many members shall this committee consist?

A DELEGATE. I move that it consist of five.

The motion was agreed to.

The PRESIDENT. How shall the committee be appointed?

A DELEGATE. I move that the chair appoint the committee.

The motion was agreed to.

The PRESIDENT. The committee also suggest that important subjects which may not be fully disposed of at the present Convention be referred to a suitable special committee, with permission to report at the next annual Convention.

Mr. WARFIELD. Mr. President, I think that involves the necessity of having the subsequent Conventions composed of these very delegates. That may not be, but I do not see that we can carry anything over to another Convention.

The PRESIDENT. The chair would state that the committee appointed by this Convention would have at least authority to report at a subsequent Convention.

Mr. ATHERTON. I would suggest, Mr. President, that it is one of the most common things for legislative bodies to appoint committees to hold over. I happen to know of two or three State legislatures which have reports before them made by committees of preceding legislatures. If the Conventions are called next year, then of course the bodies will be organized. It seemed to us simply that there might be a good opportunity in that way to help the idea of the continuity of the Convention, and that we might, in that way, secure permanent attention to it.

Mr. WARFIELD. I would like to ask the gentleman if he could present to a Convention which nominated a President, any matter coming from a committee of the last Convention, and if such a matter would be applicable to the coming Convention?

Mr. ATHERTON. Yes, sir. The last national Convention at Chicago instructed the national committee to present at the next Convention a new plan, or rather a digest of plans, for the appointment of delegates, and that report will not take effect until it goes into the Convention. We have that as a very common practice in the case of volunteer bodies

perpetuating their ideas in that way. I think the committee have no special desire about the matter, and I was about to inquire further, whether that suggestion would not come up in the course of the deliberations of the Convention. Suppose a subject gets here and our discussion thereon is not completed, and we think further investigation is desirable, which cannot be had at the time—suppose we appoint a committee. What can there be to prevent such a committee gathering together the best information of experience and observation in this country and reporting at the next Convention? We should certainly have performed our duty.

Professor KNAPP. I would suggest, Mr. President, that we have committees instead of a committee. The point was, whether it would be one committee to which all subjects should be referred or various suitable committees.

The PRESIDENT. The chair will read the recommendation of the committee:

That important subjects that may not be fully disposed of at the present Convention be referred to suitable special committees with permission to report at the next annual Convention.

The recommendation was accepted.

The PRESIDENT, having announced that the committee provided for in the recommendations would be appointed soon, said:

The chair will state to the Convention that if we take a recess, after such intermission Professor Wiley will read his paper upon "The Relations of Science to the Industries and Arts," a most important subject at the present time. The chair will now call upon Mr. Augustine J. Smith, of Maryland, to read his paper on "The Necessity of Agricultural Education."

Mr. SMITH then read the following paper:

THE NECESSITY OF AGRICULTURAL EDUCATION.

By AUGUSTINE J. SMITH,

President of the Maryland Agricultural College.

Mr. PRESIDENT AND GENTLEMEN OF THE CONVENTION: The subject upon which I am invited to address you is embraced in these words, "The necessity of agricultural education." It will be observed this language does not prescribe any particular mode or scope of treatment of the subject. I am advised it is intended to allow a liberal latitude of discussion, and using this privilege, I propose, at the suggestion of others, to treat it more perhaps from a philosophical than from a practical standpoint, as the practical phase will be fully developed by other speakers.

When the Almighty announced to the progenitor of our race, "In the sweat of thy face shalt thou eat bread," He created by that edict the great industry of agriculture and at the same time by implication, as a logical sequence, the necessity of an educated husbandry. It would have been supreme mockery to have established an industry by which man was to live, without giving him along with it the capacity to understand its laws and the desire to utilize them to the best advantage in seeking his livelihood from the soil. In proclaiming this startling decree, the Almighty at the same time signalized the advent of this great industry with honorable and inseparable association with that great law of labor which was to be the foundation of social and civil government, and by which the human race was to progress in the scale of indefinite development.

Ever since that divine fiat was promulgated, mankind has been sweating under the uneasy but beneficent yoke of labor in its various forms. No device which human ingenuity and skill or even science could invent has been able to remove the burden of this inexorable edict. The earliest ages, held yet within the swaddling bands of an unambitious infancy which had no wants that involved the life-struggles of the since progressive eras, could not have given a satisfactory reason why man's busy efforts to circumvent a wholesome command of divinity should not succeed in nullifying a law without which he would be a useless and worthless vagabond. Its yet un-

veiled, mysterious influences were too far-reaching: they were destined to extend infinitely beyond the primitive experience and to find themselves creating and controlling the social forms and forces which were to mark the development of great civilizations. It required long periods of intelligent observation and experience to obtain even a glimpse of the divine wisdom embodied in that remarkable law of industrial sweat designed to vitalize all the powers and forces of humanity and which, together with agriculture, twin-bound, were to become the foundation of all industrial life and the motor of all the useful activities which would signalize the progressive career of ever-exploring man.

The primitive workers could perhaps see nothing but an unmixed curse in a divine proclamation which to their narrow comprehension and superficial observation produced only toil, sweat, and weariness. The law of spontaneous production and a livelihood without exertion seemed doubtless to them much more in accord with divine wisdom and design. They did not feel the pressure of that law which was to bear so heavily upon the human race when the earth became crowded with population and when the lands had become so valuable that their productive vigor became an object of constant, anxious, and expensive guardianship.

It has been a long time since Abraham could say to Lot, "Is not the whole land before thee?" On the contrary, so great has become the value of agriculture, not a foot of tillable soil is to be found in any civilized country which can be had by the simple desire to possess it. In the march of civilization everything worth having has been brought under the law of labor reward, and what lands have not already passed through this wholesome provision into the hands of individual ownership are held by the Governments in trust for any son of toil who is willing to render obedience to the great command which makes one sweat for a living. To this end our Government with consummate wisdom so far from exacting a money consideration, simply requires the evidence of an honest and well-defined labor purpose upon the part of the applicant in the erection of inexpensive improvements, with corresponding honestly-meant cultivation, to secure to him the ownership of a comfortable and abundant home for himself and his household.

It was reserved for future ages, when population had become dense and when the denizens were jostling each other in the thronged thoroughfares, on the busy marts, in the crowded workshops, and too often even in the broad fields of husbandry, to discover the beneficent design of that Divine edict which, in its multiform operation, extracted the curse from the sentence of labor and left the blessing in disguise for an honest day's toil, of adequate recompense, a healthy appetite, an approving conscience, and an independent spirit which, having all its rational wants provided for, made its possessor happier than a king and thankful for his creation to the God of labor and honest sweat.

It was not until the inductive philosophy, under the protection of the Christian civilization, became the motor and patron of investigation that the law of toil and sweat was discovered to be the foundation of all that was of value upon earth. Daniel Webster uttered the highest eulogium possible upon the toil and industry of the husbandman when he formulated his views into that immortal phrase of condensed wisdom, "an enlightened agriculture is the basis of all national wealth." Another great man has added, "and of national virtue." This sentiment was as much the language of Webster the farmer as of Webster the statesman. It was perhaps in his hours of relaxation on his farm at Marshfield as he calmly surveyed his well-tilled fields, rejoicing in their bounteous yield of grain, and herds, and flocks, and snuffed the exhilarating air which expanded his great, broad chest of lungs, and invigorated his massive brain reflecting that all this abundant production was the result of skilled and educated industry, that his convictions were crystallized into the remarkable phrase just quoted. As a statesman he had doubtless observed the vast influence which agriculture had exerted through commerce in shaping the destiny of nations and races, how her products became the medium of exchange for the fruits of multiform labor throughout the world and the promoter of the spirit of universal brotherhood in man; how, through its conservative and controlling power, it had more than once stayed the arm of brutal war and bade the blood-thirsty sword return to its scabbard; how, in time through her agency international interests and international necessity would demand the substitution of the umpire of peace for the arbitrament of war. As a statesman, he had observed all this and much more. But the sentiment alluded to was greatly the inspiration of the enlightened agriculturist who had grasped at one view from an elevated stand-point the fruitful earth, the bounteous harvest, the rejoicing flocks and herds, and the happy husbandmen, and by a slight stretch of vision a little beyond, the great lines of transportation and the broad ocean highway which were to distribute the abundant surplus to the various quarters of the globe to make us the creditor and benefactor of the nations.

Here then is an industry the most ancient of all the industries, one established by Divine decree and proved by experience to be the basis of all national wealth and the promoter of national virtue. What grander foundation can be laid for any in-

dustry than this! And what more conclusive argument is needed to vindicate its claim to supremacy as the great national industry! An industry of such dignity as agriculture is entitled not only to all the consideration which a liberal and generous education could bestow upon it, but to be advanced by the national Government and by the States to a position of the highest honor as a special trust.

My subject involves, among others, the following propositions either of which being too full of suggestion to elaborate with propriety for the present occasion, I will treat briefly and generally:

First. Is agriculture worthy of special education?

Secondly. What should be embraced in such education?

Thirdly. Should such education be separate from and exclusive of or in conjunction with a curriculum embracing other sciences and branches of study such as constitute a liberal collegiate course?

If the enlightened sentiment uttered by Daniel Webster be true, that "an enlightened agriculture is the basis of all national wealth," then I need no further argument to prove the affirmative of the first proposition for this covers the whole ground. No one will be rash enough to deny that an industry which produces all the wealth of a nation should be liberally and thoroughly and specially educated. We might add the concurrent testimony of the great political economists as to the commanding predominance of agriculture in the elements which constitute the wealth and power of nations. But a little well-considered reflection will satisfy any one of ordinary intelligence and observation of the truth of this assertion. As from the earth all vegetable and plant growths spring, so out of all this production do all other industries find their being, and the sciences, arts, manufactures and commerce follow as an inevitable sequence. It might be interesting and instructive to elaborate the phases by which agriculture exerts her influence within her own realm and in her multiform relations to other industries, and again as a moral force; but the task would involve too much time and space for this occasion. I will, however, briefly allude to those considerations which present the most salient features.

I will repeat in amplification of what I have already said, that agriculture should be the subject of thorough and special education because it is the mother of all other industries and the basis of all national wealth. We have in support of this assertion not only our own observation and the statement of our great Webster, but the testimony of the greatest political economists. Hamper agriculture with unwise restrictions and all other industries suffer. Inflict unjust and onerous burdens upon it, and all other productive interests sympathize accordingly. Enslave agriculture with oppressive laws, and you paralyze and destroy the national life. Agriculture is not only the great purveyor for mankind and the motor of all the industries, but she is the great civilizer of the world. Subtract agriculture as a factor in the agencies which are striving to advance individuals and nations to the highest civilization, and you produce confusion and anarchy. This results from the fact that agriculture is not only indispensable to sustain life and perpetuate the race, but because she is the mainspring of all the industries, the power which determines their necessity and prescribes the limit of their utility, the great industrial safety-valve to relieve the overcrowded industries of their surplus and unrequited labor and thus become the medium through which the equilibrium of labor forces shall be secured and every son of toil find whereby to earn his bread.

Agriculture is also the great conservator of the peace. She can always be relied upon as the conservative, counteracting element in governments on the side of reflection, order and peace, against the reckless, turbulent spirit of crowded and discontented populations which seek anarchy and ruin. Her hardy sons keep their bodies strong and their minds clear and self-poised by pure air, wholesome food, and healthful exercise, while the confined toilers of many of the industries enjoy little or no recreation and are unable to eat the bread which they earn. The sons of the soil never suffer for want of food, raiment, or shelter, and rarely from that dyspeptic condition which produces disease, discontent, and suicide. The world can get along without other industries, but not without agriculture.

How amazingly did agriculture show her civilizing and beneficent power after the late war when amid the wreck and ruin of a large portion of our fair land she took the homeless sons under the protection of her bounty and filled the desolated fields with the heroes of a hundred battles! While wise and patriotic men of America and Europe were perplexed to know how a people who had lost their lands and homes, and indeed their civilization, were to be restored to order, peace, and prosperity, agriculture steps quietly in and solves the problem. It was simply Cincinnatus returning to the plow after duty discharged. The great leader who had pointed the victorious armies of the republic the way to the halls of the Montezumas and had just fought the greatest battles of modern times, sheathed like a hero a sword unstained by cruelty and dishonor and quietly retired after the conflict to a rural retreat soon to be placed at the head of an honored university, while his devoted followers as promptly exchanged the role of the warrior for that of the sweating son of the soil. And while

the clouds of an unfortunate struggle had scarcely passed beyond the vision the bounteous earth had crowned their labor once more with plenty in their homes and enabled them to contribute a generous proportion toward the support of a government the extent of whose necessities and expenditures were beyond all precedent. What was this but a grand achievement of agriculture? Where would the nation have been at that critical juncture without it? What other industry could have accomplished the same result? The great soldiers of history understood the importance of agriculture. The great Napoleon esteemed it justly. He knew what it was to have a reliable commissariat, which he considered more powerful than all his generals; and he assigned to agriculture the front rank as a great national industry.

Again, agriculture is a great civilizer, because she is the author and creator of the home idea, and indeed of the homes of a nation. What would any government or any civilization be worth without the home principle, the home power? Take away the homes, the agricultural homes of this glorious country and her greatness and glory will have departed. Every man under all forms of government yearns for a home. Too many governments there are that never gratify this reasonable and indeed lofty aspiration. Some of the higher civilizations only grant this in a restricted degree. Ours, the most enlightened of all nations in this direction, confers this gift equally upon all its citizens; and the strength and glory of our republic lie in the fact that every citizen of every clime and race has an equal chance to secure a home within the sacred precincts of which he can retire with his wife and children in the possession of a castle which, although without bars and barracks, is as impregnable to intrusion as a fortress full armed.

What industry can give such a home as agriculture? Bricks and mortar do not make homes. The humble cottage with its small patch of land attached is more civilizing and will engender more of the patriotic feeling of home and country than the most gorgeous palaces without a foot of soil wherein to grow a shrub or a flower. The toilers in the crowded cities have no homes, and the princes of commerce and manufactures do not feel that they have homes until they can possess a suburban retreat from which they can look out on fields, and woods, and flocks.

What makes this country of ours the asylum it is for the oppressed toilers of the Old World except its vast expanse of virgin soil? What has made the great powerful States of the West but the homes that have been carved out of her rich agricultural empire for the weary toilers of the Old World and the enterprising, free-born, progressive yeomen of the New?

Why is Ireland the land of discontent and turmoil that she is to-day? Because the landed system is such that the people have no homes. Nowhere on earth are the lands more fertile or the landscapes more beautiful than on that green isle which has given her conqueror her greatest soldiers, statesmen, and poets, and enriched her literature with its most precious treasures. But the policy of a non-parental government restricts the ownership of its lands to a privileged few. Exacting landlords, intrenched behind unjust laws, and too voracious to learn wisdom, concert too willingly with the non-protecting realm to prevent the acquisition of homes, either by tenancy or purchase by those born upon its soil; consequently they become a foreign element in the land of their birth. What a monstrous governmental mistake! A people without homes in their own country! What a striking vindication of the beneficent and civilizing influence of agriculture when left free and untrameled as in America!

How unwise and suicidal for nations or individuals to ignore the home power, *the agricultural home power;* and to refuse to recognize its controlling agency! You may parcel out the great cities among privileged and pampered classes. Ground rents and other legislative devices may withhold for an indefinite period fee titles to their magnificent piles of brick and stone and marble. Grasping and heartless capital may own their workshops and even their busy marts and hold in bonds to unrequited labor the toilers that make them rich and great. All this will public sentiment tolerate while at the same time it will deplore. But woe be to him who will seek to place manacles upon the lands of our country, upon the broad and Heaven-ordained domain of agricultural homes. This precious boon must be free to all. No law of primogeniture or long-continued inheritance is permitted to absorb or appropriate indefinitely this sacred inheritance of the American freeman. Why this profound universal sentiment of free soil and unfettered agriculture? Plainly because the Almighty, having decreed that mother earth with her wonderful productive capacities shall be the basis of civilization and progessive development to man, has implanted in his breast that to this end she must be as free in her protecting power and love as the air we breathe, and so she goes on making her homes, construction her civilization and building up strong characters and great nations.

Home influence! home power! Expunge this sentiment from the human heart, and you strike down all government, all society, all religion, all virtue, all civilization and make man a savage, a brute, a soulless, Godless, homeless wanderer on the earth.

What a touching and beautiful illustration of the sacredness and power of the home sentiment is now being witnessed. The nation is to-day standing with tender emo-

tions over the grave of a man whose name is a synonym for home throughout the civilized world. The great philanthropist of America who in kindly sympathy expended liberally his wealth to provide homes for those helpless ones who had lost their own by the incident of an unfortunate strife, is preparing to exhume, after thirty years of rest in a foreign land, all that is left of the author who, in immortalizing the home sentiment in undying verse and song, thrilled the heart of every nation and every clime with patriotic and humanizing joy. When transferred to their native land, the Chief Magistrate of the Republic, eminent officials, illustrious citizens, the learned and the uncultured, the lofty and the lowly, with hearts throbbing in sympathetic unison with thousands throughout the civilized world will follow the remains of John Howard Payne, the author of "Home, Sweet Home," to the cemetery at the nation's capital where the world-honored Corcoran will consign them to monumental rest. If John Howard Payne had been born amidst the bricks and mortar, the sandstone piles and marble palaces of the crowded, bustling city, instead of in the humble dwelling which was nestled in rural comfort beneath a bright New England sky, perhaps the wondrous inspiration which gave "Home, Sweet Home" to an enraptured world would never have found its way in verse to thrill the human heart with its soothing strains of sacred memories. It was the country life with its pure and wholesome joys for young and old in sight of flowers and fields and flocks and with the loving and loved who had shared with him alike the household joys and cares and preferred to bear all cares. It was doubtless this deeply-awakened memory and a thousand other kindred thoughts which caused his exiled and desolate spirit, his bursting brain and aching heart to utter that wail of lofty lamentation which yearned to be once more, yes, evermore amidst the sacred and precious joys of "home, sweet home."

In thus extolling the agricultural home think not I mean in the face of religious fact and daily universal proof to restrict this precious boon of home to any spot or condition of life. Only comparatively do I speak. The empty tenement in the crowded city secure against intrusion from without would gladden the heart of the shiftless, thriftless drone within in his loneliness and want, but not as a home, only as a shelter. This same abode, with plain appointment and frugal store, would be a home to the humble household, if knit by kindred blood and moved by sympathies and deeds of love, and if crowned with Christian hopes, would be a bright and radiant dwelling. The palace just beyond, though bursting with superabundant stores, would be no more but less a home on this account, if devoid of human sympathies and immortal hopes. Possessed with these, the dwellers in the marble house as the inmates of the humble dwelling, may own a home which verse and song would love to praise. But transfer these homes from the crowded city blocks, the lifeless, crumbling handiwork of man to where the eye and soul reach out and feast on nature's vast domain of beauteous scene of mountain, valley, and streams, and fields of living green where flocks and herds obtain their daily food; of woods, and flowers, and growing crops; and where the glorious king of day in purpling splendor mounts the eastern sky and the free, fresh air of quickening morn comes braced with joy and health: is not the city home improved by this exchange? Is not the country home a home supreme!

Again, agriculture is a great civilizer, because it is the great motor for mind and body in the direction of healthy and progressive development. When the Almighty formed the earth and filled its great womb with the seeds of all the plants and growths and imparted to it the fructifying principle, he at the same time endowed its productions with such value to man as would keep him ever active with his genius, skill and labor to utilize for his own comfort and gain the diversified forms of growth which were to spring forth from its bosom. This busy process reaching all the relations of society in their multiform ramifications constitutes the great civilizing principle which, starting with the propelling force of self-interest, soon discovers that through commercial and moral influences the law of labor and sweat leads to the brotherhood of man and builds up humane characters, great nations, and grand civilizations. Out of this process also grows and develops all the industries, and thus the arts and sciences assume life and organized systems and become schools for instruction. The brain work which makes the Patent Office at Washington a monument of wonder and praise to the inventive genius of our country points at the same time to agriculture as the mainspring of all that amazing thought and ingenuity.

It is not difficult to see how agriculture creates and moves commerce and manufactures, how for bread and raiment the world will bring in exchange the treasures of its uttermost depths and limits, how the pearls of the ocean, the jewels of the mines and the products of genius and labor will be laid at her feet until the dwellings of the lowly as well as the palaces of the opulent will possess some creation of the artist, the mechanic, or of handicraft in some shape which will beautify and bless.

The success of the heart-work of the world depends upon the co-operation of agriculture. The success of missionary work in uncivilized countries rests upon the law of labor. No man who does not render obedience to this fundamental, inexorable,

civilizing law of sweat can hope to be a Christian; without it he is a vagabond. Therefore, if the missionary can only get the native to work, to till the soil, or to gather with industrious hands the productions of spontaneous growth for exchange through commerce with his more favored brother for those of a more elevating and civilizing character, he can then hope to impress his moral nature with gospel truth. The small beginning with the hoe, or with the industrious perseverance propelled by the intelligent aim which produces reward and remuneration, soon expands into commerce and manufactures. Then the exchange of commodities with other peoples, followed by intercourse and interchange of ideas makes it comparatively easy to expel the heathen idols of degradation and sloth from the hitherto savage heart and enthrone in their stead the religion of Jehovah with its great doctrines of the Fatherhood of God, the Brotherhood of Man, and the mediatorial necessity of the God-man, Jesus Christ to redeem and save. This achievement begins with agriculture and is accomplished through the law of labor and sweat, as the human instrumentality.

Another reason why agriculture should be the subject of a liberal education is that she produces the bread by which man is to live and the race is to be perpetuated. A wise man has said "Show me the bread which a people eat, and I will tell you the character of their civilization." This is the language of concentrated wisdom the profound import of which it would be well if universally comprehended in all its significance. How monstrous to take the grain which the generous earth had given for bread and convert it into lead, or something as heavy and not much more digestible! Think of it! That which has been provided by nature to tempt the appetite, enrich the blood, form the tissues and build up the nervous structure for the wholesome development of mind and body, instead of assimilating and producing vigor and health, to become through ignorant manipulation and cooking a foreign element to be expelled from its own household as a matter of self-protection! Alas! too large a proportion of the bread and indeed of all food, instead of nourishing and invigorating, becomes through bad cooking an element of weakness and degeneration. It is not too broad an assertion, that the civilization of a people depends as much upon what goes into the stomach as into the brain. And while the art of cooking has been very properly committed to the custody of the female and should perhaps be embraced in the curriculum of all seminaries of that sex, yet I am not sure that its general principles should not be taught in all educational institutions and especially at agricultural colleges where many of the graduates find their livelihood in such practical paths as might often make a knowledge of the art useful to them and their employés.

My observation of the mode of living among the ignorant classes of lowly life, and indeed too often of those a step beyond, is that the food they consume rather stunts than developes mental, moral and physical growth, and that for their spiritual as well as bodily well-being the art of cooking should either precede or accompany the minister of Christ in his ministrations of love. I do not believe in readily impressing an enlightened religion any more than an elevated civilization upon a people whose bodies are not supplied with wholesome food, and whose physical welfare is not generally attended to. Dyspepsia and bodily discomforts are not easy passports to an elevating and progressive development.

While popularly, agriculture applies especially to what are denominated "crops," yet, in a broad view, it may embrace the cultivation of everything which the earth produces. An educated agriculture will diversify useful production and broaden the field of investigation and therefore of cultivation, and in the course of time many productions not now included in the popular designation "crop agriculture," will doubtless find themselves assigned a place within the realm of agriculture alongside the hops and indigo plants, and farmers who at present look to "crops" for the main source of profit may find not by any means the least item of revenue embraced in plants or growths essential to the useful arts which had heretofore escaped attention for want of knowledge. An educated agriculture will not only furnish information with reference to the use of growths already known to the arts, but will doubtless multiply the discovery of new plants. Thus by education are the revenue resources of the agriculturist constantly increased.

It must be borne in mind, however, that the great law of labor-sweat while finding its first fruits in the cultivation of the soil, was yet intended to apply to all occupations, mental as well as physical. Professional men, scientists, artists, authors, and, indeed, all useful productive vocations obtain success through the same inexorable law which supplies the busy bodily-toilers with their daily food, and they all render equal obedience to its commands in kind, if not in degree. All kinds of productive labor are beneficent in their tendencies but I doubt whether a great civilization can be produced which eliminates agriculture as an essential factor in its construction and seeks its controlling elements among the homeless toilers of the workshops of large cities, the sordid barterers in trade and the avaricious money changers of financial and commercial centers. But the civilizing power of agriculture all enlightened nations understand. In our own experience the transforming power of the cotton prod-

uct furnishes the most striking illustration of this fact in all history. It is within the memory of some now living when cotton was not known as an article of commerce. A little over eighty years ago an American ship landed in England with ten bales of cotton as a part of her cargo. She was seized because it was not believed so much cotton could be produced in the United States. For many years past cotton has not only been the great staple of this country, but the controlling product of the world and not a few wise men of enterprise have honored it with the title of the "Great Commercial Dictator." It is certainly the greatest of agricultural wonders and achievements. Certain it is, it has been the means through providentially ordained guardians of civilizing a great labor race through the industrial union of cotton and enforced labor, by which the guardian was enriched only in money, while the laborer exchanged his slough of heathenism and degradation for a civilization, a home, and a God; until now men of all sections of this glorious Union recognize in the son of Africa a brother man raised through the civilizing power of a great agricultural staple to the high elevation of American citizenship. Who so blind as to affirm that this achievement was man's doings? Had not that great staple been divinely provided when it was, the son of Africa would in all probability have been freed before his time without the ballot and perhaps have perished as a race for want of occupation. Narrow minds will not accept this theory, but the philosopher who recognizes the presence of God in history will see in the wonderful combination of soil, climate, and staple, the beneficent design of a kind and controlling providence to elevate through industrial contact with his more favored brother a doomed race to a higher plane of enjoyment than his natural surroundings could afford. What a grand triumph for our great industry! The invention of the cotton-gin, the spinning jenny, and the power-loom stimulated immensely the production of the staple and enabled it to fulfil more speedily and effectually its divine purpose.

It needs no argument to show how nations progress or retrograde as they foster or oppress agriculture. It is a matter of common knowledge how the oppressed agriculture of Turkey makes a wandering nomad of the Arab who to protect the scanty yield of his fitful labor is forced at the approach of the never-satisfied tax gatherer to "fold his tent and silently steal away" to a hiding place. And it is equally well known how this oppressed industry thrives so soon as the unjust burdens and the blighting surveillance of governmental officials are removed.

Were it not that I am admonished that the proprieties of this occasion limit this address as to length, I would be tempted to present an array of statistical facts to show how under an educated agriculture the productions of the soil had been amazingly multiplied as respects quantity, quality, and variety; how by it labor and capital had been greatly stimulated and commerce and manufactures thereby had reaped a rich harvest. It would perhaps be instructive to observe what the European nations, and especially France and Germany, have achieved in the direction of an educated agriculture. Especially should it be interesting to note the marvellous advance made in this country in everything relating to agriculture by which nothing less than expert or educated knowledge in that science and art could have produced the adequate and profitable results achieved; but all this mustbe left to those who will follow me.

As to the second proposition, "What should be embraced in agricultural education?" I answer every branch of instruction which can throw light upon the productive capacities of the soil and that will impart knowledge as to the nature, use, and development of all plants and growths which spring from its bosom. This would include researches into the physiology and diseases of plants and animals and the proper remedies to be applied. It would also necessitate the analysis of soils and artificial manures, and their adaptability to production the most profitable and useful. The proper cultivation of grasses and the most nourishing and wholesome preparation of food for cattle and all facts bearing upon the dairy products should receive attention. Floriculture and horticulture present a wide and interesting field for further development, and forestry, besides its lumber value, is assuming importance in its bearing upon atmospheric and climatic disturbances and relations. Observation and experiment are watching closely the growths of the isothermal zones with the view of determining the practicability of transferring useful plants from foreign countries to our own for development within the same range of plant life here. Perhaps we may be able to advance one step further and extend the area of plant life by some process of acclimation by which the alien growth will be so adjusted and habituated to various soils and climates as to create and distribute the blessings of plant development beyond our most sanguine conception.

Every step we take only proves the science of agriculture to be in its infancy. Its possibilities are simply incalculable and its depths fathomless. When we reflect that the Almighty is incapable of creating anything that is not intended for some use we are scarcely in sight of the vestibule of the great temple of plant mystery, much less have we been admitted into its inner courts. How few of the productions of the earth have we discovered the use of! How many there are that we have, perhaps, put to the wrong use! How ignorant we are, with all our researches, of the wondrous

possibilities of the soil and the best way to prevent its impoverishment and to preserve its productive power! Although many millions have been expended in artificial manures experience has not been able to determine so definitely their actual or relative value as fructifying agents as to place the use of them beyond probable serious pecuniary risk, save in exceptional cases. This should not be so. Does not this condition of uncertainty call loudly for an educated agriculture, and is not its existence owing to the fact that experiment has not been sufficiently directed by science and by an educated agriculture?

Distinguished and experienced agriculturists both in this country and in Europe, threaten to upset long-established theories as to the use, value, and necessity of nitrogen to the great extent used as a constituent of artificial manures. They antagonize a greater number who differ from them diametrically in regard to the issues made up, and this fact only shows how the recognized leaders differ as to the most important landmarks of the science. Both claim to demonstrate their opposite assertions by practical observation and tests. The one affirms, which the other as stoutly denies, that nature furnishes an abundance of nitrogen for all contingencies and any artificially added in any form is superabundance and useless.

I allude to this simply to should how much at sea agriculture is, when farmers of long and varied experience should, in matters heretofore considered as fixed as mathematical axioms, be called upon to halt and take new observations. I knew personally an intelligent and enthusiastic farmer, now deceased, who claimed to have successfully converted an impoverished farm of twelve hundred acres into a state of productiveness without the use of artificial manures for which he expressed supreme contempt, simply upon the theory that nature had provided shade as the only convenient, cheap, and prompt agency by which her impoverished soils were to be restored to productiveness. He claimed that nature's food for plants was what he termed "the residue of putrefactive fermentation," which he contended under the influence of shade would take place in all soils as well as in vegetable matter; that the Almighty did not leave to the ignorance and uncertainty of man's devices and manipulation the restoration of productive power in the earth, upon which all life depended; that the soil through shade would naturally undergo the putrefactive fermentation process, and thus become food for its own offspring. In proof of this he cited the fact of the tendency of all soils to construct a garment or covering by which they might protect their barren nakedness from the scorching and blighting rays of the sun. Wherever the winds would deposit leaves, or twigs, or brush, there would the latent seed struggle into life, and soon the stripling, and then the full grown pines would appear, or the sturdy oaks whose forms now grown to forest strength, having thrown their stalwart, umbrageous arms across the blighting pathways of the sun, had made the once barren and deserted waste a fruitful mother of crops, and herds, and flocks. This gentleman claimed to have farmed faithfully upon his "shade theory." He used the pea-vine and clover simply for a covering, and not as fertilizers, and kept them as long as possible upon the land that their shade might decompose the soil and provide the food thus made, and not by their own decomposition, to feed the crops which were to follow. He claimed that the droppings from the animal in the field were not in that condition plant food nor would be until they had undergone the process of "putrefactive fermentation," which could not take place under the direct rays of the sun which destroyed by evaporation the fructifying principle, but only when thrown into a pile and in shady spots where the indirect rays promoted decomposition. In short, he believed a covering of boards would enrich land as much as one of clover or any other vegetable matter, and that straw and pine brush were as efficacious for fertilization as clover or pea-vine, when properly spread, even though the latter were turned under.

I mention these ideas of my deceased friend because they are novel and curious in some particulars, and to show how widely earnest and experienced agriculturists differ with reference to matters affecting most vitally the interests of their great industry. Is there a lesson in these things, or will you chide me for bestowing the dignity of a notice upon "such a ridiculous absurdity"?

I might multiply to tediousness statements of the issues which divide intelligent agriculturists upon matters of daily experience and observation in farming but if doing so would only be suggesting that which most of you already know. The proprieties of this occasion will not permit me to elaborate opinions of my own as to disputed questions, nor is it my purpose to weary you with such intrusion; my object being to show how much there is to learn of the simplest problems in the field of agriculture, and indeed how little we know of the hidden secrets of its realm, and therefore how important it is that her treasures should be sought by the educated student and scientist by and through methods that lead to a well recognized demonstration, and not by paths which reach no definite conclusions and involve unnecessary loss of time and money,

This suggests my last proposition, "How shall such education be bestowed."

Plainly this can only be accomplished by providing scientific and practical instruc-

tion in this science and art, either in schools and colleges exclusively devoted to this object, or as an essential, and if you choose the main feature in the academic curriculum usually taught at our institutions of learning. My own judgment favors the latter method. This would enable the student to pursue the agricultural along with the other sciences and branches of knowledge which in this age of many-phased activities and intelligent progress are considered by the most ordinary observers indispensable educational requisites for the needs of practical life. Such a course should be broad and liberal enough to fit its recipient either for the professions or any of the useful vocations, aiming however in all cases to inculcate a taste and love for agriculture and to engender by proper instruction such respect for its instructive and ennobling teachings as would widen and deepen its influence in society and induce many to adopt it as a calling who, for want of a knowledge of its possibilities, usefulness, and dignity as a vocation, had learned to underrate its value and importance.

The truth is agriculture as a science has grown to such huge dimensions she is invading the domain of many of the other sciences for facts with which to enrich her own formulas, and her increasing demands for knowledge are such that she has taken possession of a number of the sciences which are considered essential to the education of the most cultured man. In a word, agriculture has become a learned science. Why not then let her stand shoulder to shoulder in the work of our agricultural colleges with her kindred sciences the peer of any or of all and be able to look with the same pride upon her educated alumni that the Roman mother of the Gracchi exhibited when she proudly pointed to her sons as her jewels? I do not mean to claim that the tiller of the soil needs the erudite, belles-lettres educational training of him who intends to pursue the career of the scholar, but I do mean to affirm that the ordinary liberal college curriculum is not too advanced to be possessed by the son of agriculture, and especially should farmers repudiate and decry as an indignity to their calling that narrow and low educational conception which would fit their sons only to occupy the position, or one very little beyond it, of the ordinary farm laborer who, although in the discharge of honest and useful and even of heroic service when faithfully performed, is yet bound irrevocably to a wearying, and too often perhaps to unrequited toil for the want of educated intelligence. And then he is deprived of the privilege which even the humblest citizen of this great country of many and glorious opportunities yearns for, to make his influence felt among his fellows and to do something to increase the knowledge and the happiness of his brother man.

In this age of expert knowledge it will not do to farm upon mere theory. Expert knowledge may constitute the profit of the farmer and a sligh mistake may destroy the fruit of his labor by sacrificing him to the unequal competition of the more enlightened husbandman. Transportation lines must move in bee lines for profit, and labor must, for the same reason, take the shortest cuts to results.

Let agriculture, then, receive special and liberal education at institutions provided with a curriculum which will embrace practical farming and experimental investigation in every useful direction, based upon scientific methods. Only in this way can all disputed questions between her scientists and farmers be settled satisfactorily and reliable conclusions reached. Thus will agriculture be appreciated and exalted as a science, and labor, which has placed it in the front rank as an elevating and useful art be justly respected and dignified. Let not the farmer of this progressive age be frightened by the cry that his son is learning too much, so long as that knowledge enables him to better understand the laws of plant life and of the soils which are to sustain it in its multiform and diversified forms. Let him not think that too much knowledge which will enable him to better handle the plough, the drill, and the reaper and after the toil of the day is over and its honest sweat removed, will be able to instruct his household as to some important matters of domestic economy, or to entertain his family and guests with instructive words relating to passing events or to one or more of the sciences or departments of knowledge which had engrossed his attention as a student within the walls of the agricultural college and which fitted him to entertain as a peer under his hospitable, rural home those who, however they may have been possessed of higher literary attainments, could not boast of acquirements of greater utility or dignity nor which could produce a greater amount of elevating and rational happiness.

When one visits the extensive city markets of to-day and observes the profuse display of well-developed fruits and berries and vegetables, the result of intelligent and educated cultivation, adding not only size, variety, beauty, and flavor, but value, and compare them with the dwarfed varieties of twenty-five or thirty years ago, how strange that any one could be found who would deny agriculture a generous education!

The two great agricultural problems, *ensilage* and *sorghum*, now agitating the public mind owe their consideration and any future achievements to an educated agriculture. The first seems to be an accomplished fact and will add almost marvelous wealth to the resources of the country. The last is still in the realm of uncertainty to the extent claimed for it as a sufficient and sole producer of all the sugar the United States

will consume. Those familiar with the difficulties of extracting a profitable amount of granulating product from the richest saccharine plants will be slow to accept the problem as satisfactorily solved which has been only worked out in the laboratory, or indeed on the larger scale of practical working, unless done under careful and skillful handling. Thus far no proper test has been made but doubtless will be by the present investigating mind which presides over the Agricultural Department. It is to be hoped experiment will cause the most sanguine dreams of the friends of sorghum to be realized. From long personal observation of its kinsman the sugar-cane plant of Louisiana whose saccharine value is not a matter for doubt I know how difficult it is to extract granulation sufficient for profit, nor is it done except by the utmost skill and with the most advanced and improved chemical and mechanical appliances. This plant is not a native of our climate but belongs to the tropics, and the crop is a forced one. I have known large crops to be destroyed in one night by a freeze which destroys the granulating principle and prevents even the manufacture of molasses. I fear sorghum will have a most difficult task to perform in working out the problem desired, not that sugar, and a good quantity, cannot be produced, but whether it can be profitably produced, is the question. And if sorghum is a forced crop like the sugar cane, the gathering of which impinges on the season of frost and freeze, its tribulations as a sugar producing staple are considerably increased. But this difficulty will be largely overcome by the improved mechanical means which converts in a few minutes the juice into sugar which used to take weeks of tedious handling. If the bagasse can be profitably converted into paper pulp, which up to this time has not been accomplished, the value of the sorghum crop will be thoroughly established. It is to be hoped human ingenuity will work this problem out.

There is no enlightened nation which fosters agriculture less than the United States, and none where the claims and possibilities of this industry are so great as in our country. The progressive nations of Europe all expend large sums annually in support of agriculture. Without enumerating tediously I will mention France, which expended last year $20,000,000; Prussia, $2,612,340; Russia, $14,826,184, and even Sweden, not larger than one of our medium States, expended $651,737, while the United States expended but $174,686. May we not well learn a valuable lesson from the old nations upon this subject?

There is no industry which returns governmental aid and protection so richly as agriculture and none which receives less of either. Being largely an experimental science, she has had much fruitless and expensive investigation to make the burden of which should not have been borne exclusively by her individuals or by her class, but by the whole or the State which reaped equally the good achieved and therefore should share equally the risk. From the nature of the case, the results of her experiments have to await their development to the end of the growing season and require much nerve to risk and not a little patience to look forward to.

Although agriculture has secured through chemistry and observation a number of landmarks which in the solution of her problems have enabled her to run many fixed lines of knowledge through her vast domain, yet she is far from being a fixed science. She possesses not the axioms of mathematics nor has she, like astronomy in her lofty observations that fixed science to aid her in her tedious explorations.

Mathematics reveling in universal sovereignty with her fixed principles and exact methods over the material world, disdains experimental modes, and finds the solution of her problems, though often perplexing, yet always certain by rules and principles always at command and which determine promptly and exactly all questions within her realm. But where is the agricultural scientist who, with his varied and so often uncontrollable surroundings, will claim to possess data or appliances of observation which will enable him to explore the hidden secrets of Mother Earth? Where is the intelligence which has fathomed the philosophy of vegetable growth? Where is the wondrous telescope that has enabled human vision to discover the nurseries of plant life or to penetrate the mysterious arcana of the seed homes in the bowels of the earth? Yet the astronomer is enabled to push his sublime explorations from the footstool well nigh the throne of Deity.

Agriculture will for wise purposes doubtless remain through all time an unfixed and experimental science, an ever busy workshop for the brain, a motor for all other industries and a civilizer for the nations. She will never possess appliances which will enable her to explore beneath the surface of the earth the silent operation of plant incubation and growth, as the telescope will detect the minutest pulsations of the restless spheres. She will never be instructed in the mystery of seed life, how bursting its chrysalis prison house it springs towards the beckoning sun and covers the earth with verdure and forest and flowers. She will never be permitted to enter that studio where the delicate brush gives the coloring which becomes exquisite tints under the transforming influence of the genial sunlight. She will never be allowed to know how the perfume is imparted to the flower or the delicious flavor to the fruit. But agriculture will be able to determine the productive possibilties, the utility and the profitable capacities of plant and vegetable growths, and how, by observing the

laws of fructification and development to achieve the greatest amount of production with the least expenditure of labor and money. In a word an educated agriculture will enable the well informed farmer to accomplish results by direct, reliable and profitable methods which the ignorant husbandman can only obtain by indirect and uncertain, and therefore by tedious, expensive and unprofitable paths.

An educated agriculture will teach man to love the earth which gives the daily food and feeds all living things; which moves all industrial life, and makes the daily toil secure the daily bread, the raiment and the home; which causes manufactures to start her busy workshops, and bartering trade to build its marts of traffic; which creates the commerce which sends its white-winged carriers and its steam propellers to every sea; which, besides the bounteous yield of crops and herds and flocks for bodily food, bedecks herself with forests, vines, and flowers, and spreads out her landscapes of mountains, vales and plains, rivers, lakes and seas to please the enraptured eye and point the adoring heart to its eternal God as source of all this wondrous wealth. Let us, then, thoroughly and generously educate agriculture. Let us honor her with educational institutions, where she will be able by her scientific and experimental methods to work out the grand problems confided to her keeping as great trusts for humanity. He who will seek to withhold from agriculture this much consideration not only fails to discharge a plain public duty, but likewise grievously ignores the almighty decree which has made her the fruitful and bounteous mother of all other industries, and therefore the controller of the civilization and the destiny of nations.

The PRESIDENT *pro tempore* (Mr. GOLD). Are there any questions to be asked of Mr. Smith?

[A pause, during which Commissioner Loring resumed the chair.]

The PRESIDENT. The next paper to be laid before the Convention will be that of Professor Wiley, of Indiana, on "The True Relations of Science to the Industries and Arts." This may give rise to some discussion, and as there is a question in the minds of some of the members with regard to a recess, I would suggest that it is now half past 1, and if the Convention be disposed to have a recess, I think it had better be taken at this time. The chair will entertain any motion upon that matter. So far as the chair is concerned, there is no objection to going on, but I do not know that this would be convenient to many of the members. What is the pleasure of the Convention?

A DELEGATE. I move that we proceed to the reading of the paper.

Mr. ATHERTON. May I ask, before that motion is put, whether it is contemplated to hold evening sessions?

The PRESIDENT. I think not. The meetings can be held until 5 or 6 o'clock, but I hardly think that evening sessions will be practicable.

The motion, as above, was then agreed to.

Mr. COFFIN, of Iowa, thereupon took the chair, and

Professor WILEY, of Indiana, read the following paper:

THE TRUE RELATIONS OF SCIENCE TO THE INDUSTRIES AND ARTS.

By Prof. H. W. WILEY.

Science is the mother of the industries and arts. I propose in this essay to set forth this maternal relation and briefly illustrate its conditions. An industry or an art is applied science. This science is sometimes the result of theory, but more often the offspring of experience. Science is knowledge of matter and the laws which its action reveals. Every industry and every art is directly dependent for its success on knowledge of the matter worked upon and the laws of its existence. To know something of the nature of ores and of metals is indispensable to even the crudest forms of metallurgy. Tubal Cain had first to devote himself to science before he could become a worker in brass. Blot out of existence what science has revealed of the nature of metals, and the progress of the world would at once be stopped, and all civilized nations relapse into barbarism. A beautiful illustration of the relation of science to the arts is found in the manufacture of steel. Chemistry revealed the fact that steel differed from wrought iron mainly in its content of carbon.

The chemist also learned that cast iron is richer in carbon than either steel or wrought iron. In the process of puddling the extra content of carbon in cast iron is gradually burned out. This led the chemist to believe that if this combustion could

be stopped at the right time the manufacture of steel could be rendered much cheaper. This idea eventually took shape in the Bessemer converter. As a result, every industry and every art has been immensely benefited. All tools for the machinist, the carpenter's planes, the farmer's plows, have felt the influence of this discovery. It has netted the continents with steel rails, and thus cemented the ties of international friendship. It has made steel-plated ships in place of the oak hulls of our fathers, and has profoundly affected the progress and wealth of the world. Cheap steel means plenty of work, good wages, and cheap bread.

Cheap steel is a great civilizer and a great missionary. The most bigoted heathen idolator, who remains unmoved by the sincerest and most potent appeals of the devout missionary, would not endure for a year the exhortations of a *Bessemer* converter. If science had never done anything for the world other than making cheap steel a reality the world would be to science a hopeless debtor. What is true of the steel industry is true of every metallurgical process. We are apt to forget in the rifeness and success of a business how it arose and by what fostering care it was protected.

In this day, however, when most of the industries and arts have already advanced to a fair degree of perfection, we are not practically interested in how they had their origin. This is a question more of historical than of practical interest. Science however has not lost its vital relation to industry by this advancement. Having been the source from which the industry sprang, it remains the protector and promoter of industry. He is filled with a false and dangerous pride who maintains that any science or art has attained its perfect development. In such self-satisfaction are always found the roots of decay. True, much has been accomplished, but much yet remains to be done. We may then propose as the chief theme of this essay, "Science, the guardian of industry and art." And, first: What are some of the ways in which this guardian care is to be exercised? First, I will answer, science must furnish an educated body of workmen. Industrial education is the first great duty of the State. Congress never enacted a wiser law than that which set apart a certain portion of the public domain for the purpose of encouraging technical education in the various States.

It would be out of place here to criticise the disposition which has been made of this munificent gift. It would be easy to point out blunders and mistakes. Blunders arising from lack of judgment and mistakes arising from ignorance. What is to be considered now is the *intention* of this grant. And this certainly was of the best. The great demand of our country, rich in reality, rich a thousand times in near possibilities, is educated craftsmen. In our eagerness to get wealth, in the wild exuberance of our growth we have neglected too much the demands which the near future will have upon us. Our fields will not always be fertile without fertilizers; gold will not always be found in the river sands, to be had for the collecting; we cannot always look to Europe for the finest works of skill. This country is too large, its wants too gigantic, to be supplied by foreign hands.

Science therefore comes forward and offers her help in giving to the youth of the land a technical education. The education which science offers is not of the brain alone. There is no dearth here of lawyers, and doctors, and preachers, and novelists, but science recognizes the fact that a human being has a spinal cord as well as a cerebrum. Backbone is the watchword of technical education.

Heine, in that beautiful and satirical poem entitled "Deutschland," speaks of the shadow that seemed to follow him one night through the streets of Cologne. It dogged his steps like a *spiritus familiaris*. At length he stopped and addressed it, "Who art thou?" "I am" said the shadow, "the deed of your thoughts." So the spinal cord is the "deed" of the brain's thoughts.

All work of skill, all cunning and delicacy of handicraft are the results of educating the spinal cord. The anatomist will tell you that all the nerves that control or rather direct motion spring from this sensory center. And herein lies the great hold which true science has on every industry. True scientific study has always something for the hand as well as for the brain. Science without the laboratory, is a ship without a sea. In the study of botany we find the hand at once engaged. The manipulations of the magnifying glass and of the dissecting implements teaches at once a skill and dexterity which are never without their value. The chemical and physical laboratory is even richer in culture for the backbone. No student can earnestly pursue the study of these sciences in a proper way without securing a technical training that will prove a lasting benefit. Men must produce as well as consume. Mere abstract reasoning is a good thing, but men cannot live on abstract reasons. Even turnips are more nutritious than abstract reasons. Fairies can "live on lover's sighs," but shepherds and lord chancellors must have something more substantial. But science study, in order to have its true technical value, must be pursued in a scientific manner. What has caused science to be looked on with so much suspicion by many practical men? I answer, humbug. Much of what has passed for science in this and other countries has been the flimsiest shoddy.

In many places of instruction the object seems to have been simply "cram." Dead and dry platitudes have been forced down the throats of unwilling subjects to absolute nausea. So-called science has been taught without a single idea of what real science is. What, then, could you expect in the way of results? Nothing; absolutely nothing but disgust and distrust for everything which was suspected of being scientific. Such science as this has no relation whatever to any art or any industry. Even agriculture has not been free from these pretenders and their nostrums, and it has been pelted and pestered in the name of science with so much that is irrelevant and nonsensical that no wonder is to be expressed at the hearty disgust which it has so often manifested. But happily, these doleful days are passing away and the dawn of the era of true technical training is dispelling the darkness which has kept scientific claims from appearing in their true light.

There is no art or industry which is not vitally interested in this technical training. In this training I am sorry to say we are far behind Europe. If we go into any of our factories where work of skill is required it is surprising to find how large a percentage of the workmen are of foreign birth.

Every true friend, therefore, of the industries and arts of our country must look with especial favor on the efforts that have been making during the past few years to build up in our country a vast and thorough system of technical training. Some may be disposed to complain because this system has so far yielded no striking results. But this is not just. The most valuable products are not taken from things immature. Time must be given for growth before demands are made for production.

In agriculture, the great and overshadowing industry of this land, how few are taking advantage of the scientific education which nearly every State offers her citizens! In one great State of two millions inhabitants, a State with fertile soil and a favoring climate, not fifty young men are pursuing the thorough course in experimental and practical agricultural work which the State and country have provided.

Manual labor is the source of all wealth and happiness. No man fully fills up the full stature of manhood who shirks it altogether. To labor with the hands is as honorable as it is necessary to human existence. Science encourages this habit of manual labor, and at the same time directs it to the best and most profitable results. Considered in all its aspects, therefore, we must allow to science the possession of a most intimate relation to all that pertains to real industrial and artistic achievements. Most certainly must we admit that, as society is at present arranged, it would be quite impossible that every artisan should receive a thorough scientific education. Most boys and girls are financially debarred from this. The eternal and insistent cry of the stomach is the first business which every person must attend to. When this is accomplished, in most cases, there is no time or opportunity for anything else. I have no Uptpian view of universally technical education to offer here to-day. In these matters I am neither pessimist nor optimist, and only an agnostic by necessity. But if the cold facts of existence must make ninety-nine shiver through life let the one be warm, and be able to devise means whereby the ninety-nine may shiver less. One thoroughly educated artisan will prove an inestimable blessing to a community of uneducated artisans. And so it happens that, while science works apparently only for the few, in reality it is the many who reap the great benefit.

Perhaps it would be well to illustrate by a few instances how scientific training and science methods have proved beneficial to an industry, and I do not know of any more striking example than that great industry in whose interest we are here to-day. I will cite first what science has done in working up the refuse of civilized life into useful products. One or two instances of this will be sufficient. Take the case of bones. Chemistry has shown that bones contain a large amount of phosphoric acid. It also showed that this acid was an essential constituent of plant life, especially of the cereals. This was the beginning of a great industry. Bones which before had been the pest and plague of cities and towns were carefully collected, ground and returned to the soil as a most valuable fertilizer.

Science also showed that the nitrogen of plants was not taken from the nitrogen of the air, at least only in small quantities. On the other hand, it appeared that nitrogen in the form of ammonia was most readily absorbed. This led to the guano beds and the cess-pools. What was before considered not only worthless but really noxious, was now easily sought after to enrich the soil. It was also discovered that plants did not assimilate organic particles as such, but that all these had first to undergo decomposition before they could be used as plant food. This fact reconciled people to the use of plants as food grown with fertilizers that were most offensive to thought and sense.

You may macerate a growing potato in starch, it will not absorb a single grain of it. You may soak the growing cane in sugar, the juice will not be one whit the sweeter. You may pour linseed oil around the roots of growing flax, the seed will yield no more under the hydraulic press than before. In all the above cases it is of course understood that the yield will be no greater than if an equivalent amount of inorganic matter had been supplied instead of the organic.

A striking case is found in the gardens of Asnieres, near Paris. These gardens, which now exhibit the luxuriance of the tropics, a few years ago were worthless fields of sand. Science has converted them to their present beautiful state. It has done this by bringing to them the poisonous sewage of Paris. Here, if anywhere, the plant will find opportunity to absorb these filthy organic matters.

But the vegetables and fruits produced here are as free from sewage taint as if they had been grown on the virgin soil of a western prairie.

Here we see hundreds of acres covered with splendid vegetables and luscious fruits, which only yesterday were expanses of yellow sand, on which a few struggling weeds eked out a miserable existence.

In this manner, by the triumphs of science, the seeds of disease and the breath of pestilence have been made to bring forth health and wealth, and an arid waste has been transformed into a blooming field.

There, by the eye of scientific faith, in the blushing raspberry we see a metamorphosis of *cholera infantum*, now become a preserver instead of a destroyer of the children.

Deadly fevers appear, divested of all their terrors, in bulbous cabbages and pendent beans; miasma is seen quivering in the leaves of the apple and the pear, or secretly instilling its jaundice into the velvety coat of the peach; devastating cholera, green and glaring, writhes and wriggles in harmless rage through the vines of the cucumber, or loses in the prickly surface of the gooseberry its sting of death.

Science is scarcely less valuable as a scavenger than as an inventor. In all the industries what to do with the waste product, is a question of no less importance than the value of the chief product. In the meat-making industries this economy of science is set forth in a strong light. No part of the animal tissue is now thrown away, where a few years ago there was an enormous waste. The hair, the hide, the vital organs, the hoof, the horn, the blood, and the bones have all found a valuable application. This saving of science has come upon us so gradually that we are not aware of its value. One pork-packing house in Chicago has lately said that it saved annually in waste products $200,000, which were lost twenty-five years ago. With such a fact as that on record, only the veriest infidel could doubt the economic value of science. In the economy of nature there is no waste. Returning from this digression, I will illustrate a little further what science is doing in the industry of agriculture.

I will say little of the relation of chemistry to science. This theme has been often and thoroughly discussed.

Munich is happy in the possession of magnificent museums of painting and sculpture. The Glyptotek is a vast marble place; in style, resembling the temples of ancient Greece. This majestic hall is filled with the master-pieces of sculpture, gathered by skilled hands from all quarters of the globe.

We find there statues of Egyptian priests chiseled one thousand four hundred years before Christ; we find marble vessels used for holding the entrails of animals sacrificed by the earlier Pharaohs.

In the hall of Apollo we saw on the one hand a colossal bust of Bacchus, the god of the vintage, and on the other a beautiful torso of Diana, the virgin huntress. One wanders from hall to hall, bewildered by the prolixity of art, and oppressed with the presence of antiquity.

In the old and new Pinakotheks is found even a greater degree of excellence in painting, and also a more lavish display of abundance than the Glyptotek had shown in sculpture.

The masterpieces of Holbein, of Claude Lorraine, of Rubens and Michael Angelo decorate every wall, and fringe the triumphs of skill with the halo of genius. Without, in the city, long streets bordered with bronze statues and ending in triumphal arches, lure the visitor on to admire their beauties and recall their histories.

Everywhere are Frenchmen, Englishmen, Americans, who have been attracted by all these wonders of art and have come, some to take a passing glance at them and others to study them more at their leisure.

But there is one place in Munich rarely visited by travelers. That place is found with some difficulty, and one enters a narrow and muddy court and finds his way into a dingy and dirty room. This room is ornamented with no chiseled marble, nor are its walls frescoed by the hand of old masters. The windows are small and low, and the plaster yellow with age and smoke. Yet this humble room has seen greater triumphs than any of those which adorn the galleries of art, or are celebrated in the monuments of the streets. It has seen triumphs of toil and of genius which have not merely made one man famous, but have also made millions comfortable and happy. It has seen triumphs which have not filled long trenches with the dead and huge hospitals with the wounded, but triumphs which have made fields of peace fertile, and filled granaries to the top.

It is the laboratory of Justus Von Liebig, the founder of agricultural chemistry, the benefactor of his age. Liebig himself is dead, but I seem to stand in the presence of

his great genius, and to feel the inspiration of his wonderful industry and application. There is no other one place in the world which illustrates so convincingly the intimate relation existing between practical science and rational agriculture.

The work so splendidly begun by Liebig has not been allowed to languish with his death. Problems which he left unfinished have since been solved and new questions have been asked, which are now answering from a hundred experimental stations. Chemistry has the same vital relation to agriculture that anatomy and physiology have to medicine. The alleged doctor who does not know the locality of the heart is no more at sea in his practice than the farmer who does not have at least a practical knowledge of the nature of soils, fertilizers, and crops. Ignorance of these things is not bliss, it is crime.

Another intimate relation of science to agricultural industry is found in

METEOROLOGY.

Next to the soil, *climate* and the *weather* are the most important factors which enter into the agricultural problem. The science which studies these phenomena, discloses the laws which govern them, and foretells their occurrence, is called *meteorology*. The weather not only makes crops, but it may also ruin them. To be able to know the state of the weather forty-eight, or even twenty four, hours in advance would save many a dollar annually to every farmer. It is true that an ancient writer has said, "In the morning sow thy seed, and in the evening withhold not thy hand." But we must remember this was written before the days of the signal service and modern science. The farmer, warned of an approaching storm, would not cut down six acres of grass in the morning to have it soaked with rain in the afternoon. With forty-eight hours warning he could complete the planting of a field before the rain, instead of having to leave off in the middle of the work and then leave the other half without the benefit of the rain. With such a warning he could secure a field of ripened wheat and save it from being prostrated by the wind or torn in shreds by the hail. In fact there is scarcely a farm process that would not be better done or more timely done could the state of the weather be known in advance. The ancients fully realized the importance of this matter. That agricultural poet, Virgil, thus advised the Roman farmers: "But before we cut up the unknown plain with the plow, let us be careful to foretell the winds and the varied manner of the weather." [Georgics, Lib. I., 50–52.]

As in ancient times so still do we gain a good idea of the coming weather by observing the moon and sun, wind and cloud. Farmers now as then "pray for moist summers and dry winters. Corn is made joyous and the field glad in the wintry dust." [*Ibid.*, 100–162.] A circle round the sun "betokens a great storm for farmers and for the sea." Before sunrise rays shooting up through the clouds indicate hail. "If the sun is spotted on rising or especially if half his disc be hidden by a cloud, a showery day may be expected." [*Ibid.*, 441–442.]

"An azure color of the sky at sunset threatens rain." "A spotted sunset warns of storms." "If the sun both rise and set clear you need not be frightened by clouds during the day." Such are some of the indications which Virgil tells us were derived from the sun.

Respecting the moon, we learn from the same author that a red color of the moon indicated wind, "*rento semper rubet aurea Phœbe.*"

If the new moon rose and set clear on the fourth day all that month would be pleasant and free from rain.

It is easy to see that many of the signs of the weather which were relied on two thousand years ago are still considered valid at the present day. We are still able to judge by the sun, the wind, the cloud, and the rainbow, while all of you have heard the weather-wise predict the weather for the month from the appearance of the new moon about fourth day, just as was done so long ago. We must remember, however, that it is still now, as it was then, somewhat uncertain to prophesy from these phenomena, either singly or collectively; and especially is it likely that "all signs will fail in dry weather."

Quite in contrast with the interest exhibited by the Romans in this matter was the apathy which prevailed no more than forty years ago. Speaking of this topic and that time, Liebig [Einleitung zur Agricul. Chemie, 9th Auflag., ss. 4 and 5] says: "No attention was paid to the latitude of the place, its height above the sea, the yearly mean of rainfall, the rainfall of different seasons of the year, the respective number of fair and cloudy days, the mean temperature of the year and of the different seasons, the extremes of temperature; no regard was had for the physical, chemical, and geognostic properties of the soil."

Since the time spoken of by Liebig, however, quite a revolution has taken place with respect to these things. Every civilized Government has instituted a thorough system of meteorological observations taken at different stations and representing the mean of the whole country. These observations, it is true, were first undertaken for

the benefit of commerce, but they are far more likely in the end to prove a greater benefit to farmers. As a result of this, agricultural stations generally have undertaken similar series of observations, whose data can be added to those of the Signal Service proper. And here I will say with as much emphasis as plain statement can imply, that I regard the predictions of the so-called weather prophets like Tice, Vennor, and others of that ilk, as too preposterous to merit contradiction. And yet these vagaries of monomaniacs receive a quite general credence. People might just as well fix their meteorological faith to the predictions of the Patent Medicine Almanac. But it is quite different with a scientifically conducted signal service. The area of low pressure sent from the various parts of the country shows the direction of the winds. The telegraph also shows in what direction these areas are moving, and the anemometer tells the rate of their progress. These data, in connection with the temperature, the season of the year, and the degree of saturation of the air furnished by the hygrometer, give almost absolute data for predicting the kind of weather.

We should remember, too, that the Signal Service is still in its infancy, and that the maximum of scientific skill has by no means been reached in the interpretation of its data. But in spite of its infancy and consequent lack of perfection, its predictions are already quite reliable and receive everywhere a due amount of credence.

It is true, also, that storms which are vast in extent can be more certainly and sooner predicted than those merely local. But with the increase of signal stations even the latter will be foretold with almost absolute certainty.

Then the next difficulty which science has to remove will be the one connected with the distribution of these indications among farming communities. The merchant in the city, at breakfast, glances at the *indications* in his morning paper, and, in accordance with their predictions, either takes his umbrella to his office with him or else leaves it at home. But the farmer in the country has not this opportunity of deciding whether to cut his field of clover or not in the morning, with the expectation of getting the product under cover before night. This is not a proper place to discuss the means by which this information is to be conveyed. It could be easily done by the telephone and fourth of July flagstaff. Danger signals of an approaching storm could easily be placed so that they could be seen by every farmer before beginning his day's work. Or instead of the flagstaff, signal guns might be employed, and gunpowder and cannon thus be trained to serve the arts of peace instead of the furies of war. It will be enough to affirm now that whenever the Government sees fit to go to even a moderate outlay, science stands ready to put every farmer in the country *en rapport* with the Signal Office in Washington.

And since it thus appears that the Signal Service is chiefly for the benefit of that industry which raises our crops, and the one that carries them beyond the sea, cannot one pardon a suspicion that the Signal Service might do better under the peaceful flag of the Department of Agriculture than beneath the red and raging banner of the War Office? But this is a thought which must only be whispered in desert places, in tones as tremulous as the timidity with which it is now suggested.

BIOLOGY.

That part of biology which I shall mention as peculiarly beneficial to agriculture has reference to the study of domestic and useful animals, and the laws of their variation and improvement. I am aware that this theme, in a strictly etymological sense, does not fall under the head of agriculture; but, by immemorial usage, it has become a part of agriculture, since every farmer makes use of animals in doing the work of his farm, and is also, to a greater or less extent, a keeper of herds and flocks. Whatever, therefore, tends to improve the character or quality of his domestic animals proves of immediate or ultimate advantage to the farmer.

In this way the science of biology in its special branches of *variation*, heredity, and natural and intentional selection has been of the greatest benefit to agriculture. As with the other sciences, so with this, we believe that the good which it has already done is but a beginning of what it will eventually accomplish. Science has shown that every species, and in fact every variety, has an inherent power of variability. It thus happens that the individuals of the same species or race, while they have a close resemblance to one another, are not exactly alike. Even the offspring of the same parents, when subjected to the same conditions of existence, as in the case of twins or polygenesis, are easily distinguished from each other. This variation from the type may be greater or less; usually it is very slight. Sometimes it is so great that it is called a monstrosity. By crossing different species, to produce hybrids, as in the case of mules and hinnies, a progeny is produced in which the variation from the parent forms is more marked. Hybrids often seem to possess characters which are almost a mean of those possessed by their parents, while often, also, by a certain prepotency of generative force in one or the other of the progenitors, the hybrid is attracted to one or the other of the species from which it is produced. But this variability

in animals would prove of little use to man were it not for another principle, the law of heredity, which science has also discovered and formulated. While it is true that the offspring varies more or less from the parent, it is equally true and equally as important that there is also a greater or less resemblance between them. From this it happens that there is always a tendency for the parent to transmit to the offspring those peculiarities which are its distinguishing marks. Let us combine now with the two foregoing principles, viz, *variability* and *heredity*, that of *selection*, and we have the basis of the improvements of breeds, upon which every scientific farmer acts. Science, in the last few years, has, as thoroughly as time and opportunity have permitted, investigated the phenomena of variability, heredity, and selection, and as a result the practical man has now at his disposal a vast array of facts, which, a few years ago, were wholly unknown to him.

Many of the causes of variation have been discovered. Chief among these known causes are climate and conditions of life. Thus meteorology again comes into play as an important factor in practical agriculture. Others are still unknown, but we do not despair of the discovery of many of these. Heredity is a natural principle so well known that we are astonished only when it fails to act. But science has done much to sort out and arrange the facts connected with its phenomena, although its laws have not yet been formulated. Science has shown that *selection* is a universal principle, and that it is of two kinds, *natural* and *conscious*, though it is not implied by this classification that conscious selection is unnatural. A good general example of conscious selection is the well-known fact that breeders generally keep the finest animals for breeding purposes, and thus keep their animals up to a high degree of perfection. In this way science, consciously or unconsciously, continually improves the condition of animals.

A few examples, illustrating the topic under consideration, will serve better than any argument of my own to show what science may thus accomplish.

EXAMPLES OF VARIABILITY, SELECTION, AND HEREDITY.

In the horse, conditions of life and climate produce the greatest variations. Mr. Charles Darwin, in his classical work on variation of domestic animals, gives some curious instances. Horses become "greatly reduced in size and altered in appearance by living on mountains and islands, and this is due apparently to want of nutritious or varied food." [Animals and Plants under Domestication, American edition, page 69.] The horse can stand great cold. He is found wild in Siberia, as far north as fifty-six degrees; also, where it is very hot the horse flourishes, as in Arabia and Africa. A very moist climate seems to be more injurious to the horse than extreme heat or cold.

The English race-horse shows the effects of selection. These horses are descendants from the mingling of three races, called Arabs, Turks, and Barbs. Yet the improvement in these horses has been so marked that when descendants from the same stock of the first generation compete in the races, they are always allowed certain odds. As an example of heredity in racers may be mentioned "King Herod," who gained in prizes a million dollars, and was the father of four hundred and ninety seven winners. "Eclipse," another great racer, was the father of three hundred and thirty-four winners. A German writer has asserted that there is not a successful racer on the continent of Europe which has not English blood in his veins.

With respect to sheep equally as valuable data have been collected. Quatrefages [Human Species, p. 248] says: "Our (French) sheep on being transferred to America generally become acclimatized without undergoing great change. Their fleece, particularly, is retained. But on the plains of the Meta it is only retained on condition of the sheep being regularly shorn. If they are left to themselves the wool becomes of a felty nature, is detached in flakes, and is replaced by a short, stiff, and shining hair. Under the influence of this burning climate the same individual is in turn a woolly and a hairy animal." A cold climate even is capable of producing wool on animals which naturally do not have it. Some "pigs with fleece are found in the cold plateaus of the Cordilleras; sheep with hair in the warm valleys of the Madeleine, and hairless cattle on the burning plains of Maraquita." [*Ibid.*, p. 226.] In the East there is a remarkable variation in sheep, by which a race has been formed by selections in which the tail is very long and deeply laid with fat, which is considered a great delicacy. So highly prized is this character that the animals are furnished with trucks on which they drag their precious tails about from place to place." [Darwin, *loc. cit.*, Vol. I, p. 120.] The differences in the texture of the wool, which make some races, like the pure Merinos, so valuable, have arisen by the combined influences of climate, heredity, and selection, and it is only by the most careful attention to selection that the fineness of the wool can be retained in other than the same climates in which it was at first produced. A remarkable instance of variation, which by heredity and selection was made to produce a new race, took place in our own country.

"In 1791 a ram lamb was born in Massachusetts having short, crooked legs and a long back like a turnspit dog. From this one lamb the otter or Ancon semi-monstrous breed was raised. As these sheep could not leap over the fences, it was supposed they would be valuable." [Darwin, *loc. cit.*, Vol. I, p. 126.] This breed, developed by selection, transmitted its character so perfectly that Colonel Humphreys, who made a special study of it, never heard of but "one questionable case." When the Ancons were placed in with other sheep they would keep together, gradually separating themselves from the rest of the flock.

Another instance, also cited by Darwin, relates to the formation of the Mauchamp breed. In the year 1828 a Merino ram lamb was born in France which was remarkable for its long, smooth, straight, and silky wool.

In 1833 M. Graux, the owner of the lamb, had raised enough to serve his whole flock, and in a few years more he was able to sell stock of his new breed. The wool is regarded so highly that it brings 25 per cent. more in the market than the best pure Merino.

Variation also frequently manifests itself by producing changes in the functions of the animal's body or some of its parts. These changes are mostly due to climate influences.

The Egyptian goose brought to France in 1841 by Geoffroy St. Hilaire is a striking example of this. "At first this bird laid its eggs in December, as in its native country. It raised its brood in the depth of winter, and, consequently, under very unfavorable circumstances. In 1844 the birds began to lay in February; in 1845 in March, and in 1846 in April, at the same time as the native goose." [Quatrefages, *loc. cit.*, p. 226.] Sometimes instead of climate other forces are active in producing similar results. Thus: "The wild sow litters but once a year and with only six or eight young, but when domesticated litters twice a year with from ten to fifteen pigs. The fecundity of the Indian pig is seven times as great under domestication as in a wild state." [*Ibid.*, p. 45.]

On the other hand, there are some animals which appear to be less fruitful when tamed than when in the wild state.

I will not multiply these examples further. Those who feel like pursuing the subject will find abundance of materal, collected from many classes of animals and different parts of the world, in Darwin's work, to which I have already referred.

These examples show what good results can be accomplished by paying strict attention to the laws which science has already discovered, and what progress we may expect from further investigations in the same line. There seems to be no more promising field for developing the relation of science to agriculture than in the one at which we have just taken a glance. A long series of carefully conducted scientific experiments will still be needed before we are able to determine what sheep will give the best wool in our climate, what cows the best milk, and what hogs the best pork.

In fact there is not a single domestic animal which, by careful attention to variation and careful crossing and selection, may not have its nature better adapted to our climate, and thus become more profitable to the farmer. It is a good work and worthy of diligent prosecution.

BOTANY.

The science of botany is justly regarded as having a very intimate relation to agriculture. I have already indicated in a previous part of this paper how a botanist may be of great use in an experimental station in the examination of seeds. In the seeds of varieties, for example, nearly allied to each other, the seed may be so nearly alike that a skilled botanist will be required to detect the difference.

Taking advantage of this similarity, the unprincipled seller may mix the seed of a comparatively worthless variety with one which is highly esteemed and sell the mixture for the best seed. Just as often a dishonest grocer will mix coffee at thirty cents with coffee at forty cents, and sell the mixture for fifty cents a pound.

But the usefulness of botany to agriculture is not limited by the examination of seeds. It extends to a much wider field of activity.

It is known that all I have said of the variability, heredity, crossing, and selection in animals is equally true of plants. I will, therefore, not repeat here the course of reasoning used there to show the usefulness of a scientific knowledge of these principles to the farmer. I will only say that as the farmer has to deal rather with plants than animals, the arguments have proportionately the greater weight here.

To variations and selections, crossing and heredity we are indebted for all the different varieties of the cereals and other plants which make them so well adapted to the different countries and climates in which they grow. As in the case of animals, I can best illustrate this by a few examples.

VARIATION, ETC., IN WHEAT.

"The Abbé Tessier sowed autumn wheat in the spring. Of a hundred seeds which germinated only four ripened their seed. One hundred seeds of this crop (also sown

in the spring) produced fifty fertile plants. In the third generation the whole hundred seeds ripened. An inverse experiment produced similar results." [Quatrefages, *loc. cit.*, p. 226, and Darwin, *loc. cit.*, Vol. I, p. 380.]

The fact that good seed tends to produce good crops has been known from the earliest times. Darwin states that the careful selection of seed-corn was recommended in ancient times by Calumella and Celsus, and especially Virgil, who says in his Georgics:

> I've seen the largest seeds tho' viewed with care
> Degenerate unless th' industrious hand
> Did yearly cull the largest.

Wheat has been cultivated from the remotest antiquity, and without doubt the principles of selection have been practiced from the first. It is thus probable that the limit of perfection, as far as selection is concerned, has long since been reached. It is not strange, therefore, that the wheat of the present day does not appear any finer than wheat from Egypt raised three thousand years ago. Nevertheless, when we compare our present wheat with some which was raised in Switzerland during the neolithic period, perhaps a hundred thousand years ago, we are able to see that the variety has been greatly improved. The seeds are both larger now and more numerous in the ear.

The chief value of selections, therefore, at the present time, is to preserve the high standard reached, while the botanists and experimenter must depend on crossing and accidental variations for the genesis of new varieties better suited to any given conditions of life. Nevertheless, existing varieties can be gradually acclimatized when taken to a strange country. In Sierra Leone where wheat was first sown it nearly all ran to leaf. The ears were few and poorly filled. When the seeds of this crop were sown many failed to germinate, but others grew and were much more fertile than the first crop. After a few years the wheat became as fertile as in its native country.

Another striking illustration of the effect of acclimatization in plants is afforded by the crysanthemum. This plant, which is now so commonly seen, came originally from China. "Introduced into France in 1790, it flourished there and produced fruit which it was unable to ripen, so that commerce alone supplied gardeners with the necessary seed for more than sixty years. In 1852 a few plants were observed to flower and to fruit sooner than the others. The seed ripened, and France now produces all the seed which she requires." [Quatrefages, *loc. cit.*, p. 224.]

Variation in the one species of cabbage has been most remarkable. By careful selection nearly fifty races have been produced and nearly one hundred and fifty varieties, extending all the way from the full-headed kind to the cauliflower.

In high northern regions the summers are short and the days long, and all kinds of crops grow there faster than in temperate climates, where the days are shorter and the summers longer.

In South Germany barley will grow and ripen in four and a half to five months; while in Lapland and Finland the same process is accomplished in two months.

Our common corn, as is well known, in Minnesota has six weeks less time to mature than in Southern Indiana and Kentucky, yet it soon adapts itself to the changed conditions. But if seed were taken from Kentucky and planted in Minnesota but few stalks would mature their seed the first year. Perhaps three or four years would be required for it to become perfectly acclimated. Thus, by easy inference, we see that where it is feared that frost will come too early in the fall it would be wise in the farmer to bring his seed each year from the North, and thus grow a crop which will ripen two or three weeks sooner than the acclimated plants.

By thoroughly trying experiments like these at our agriculture stations, botany may prove of immense advantage to the farmers of the country.

But I will not attempt here to show all the relations which botany holds to agriculture. There are a dozen directions in which its lines of useful force operate, and it would be wiser to leave a complete exposition of the subject to the professional botanist, who would bring to the task a richness of knowledge and facility of expression which would place the subject in a much stronger setting than I have been able to give it.

ENTOMOLOGY.

One of the numerous difficulties which adds to the burdens of the agriculturist is the fight which he is constantly compelled to carry on against injurious insects. Almost every year he is compelled to engage in an unequal contest with the potato bug, the fly, the weavil, the caterpillar, and the borers of his fruit trees, while at intervals the locust, the army-worm, and the grasshopper pour over his fields with resistless power. It is the province of the entomologist to study the habits and methods of reproduction of these injurious insects, and to provide some way to arrest their almost marvelous fertility.

Much has already been accomplished in this direction, but much more remains to be

done. It is evident that it is useless for a farmer to fight potato bugs in his field, while they are left to increase unmolested in the field of his neighbor. Action against insects must be concerted and intelligent to be effective. Bushwhacking and guerrilla warfare can never accomplish anything more than a local result. The campaign, to be effective, must be regular, with full equipments and a perfect knowledge of the ground to be fought over and the number and disposition of the forces of the enemy.

The farmer looks to the entomologist to direct him in the campaign and furnish him all needful information.

With such scientific aid he should not despair of eventually freeing his fields of these insignificant but destructive pests which now cause him so much loss and trouble.

These are only a few instances of the true relation science bears to one industry. The argument becomes cumulative as other industries are considered and other ties which connect them to science are discovered.

In these illustrations peculiar emphasis has been given to the real monetary value of science in the industry. And say what we will, this is the measure which is the final test of all value in every industry. What does not pay, at once or ultimately, will never find a lasting place. This does not arise from the fact that men are wholly mercenary, but happily from the fact that nature is so constituted that it is the *best* that always in the long run pays best.

Herbert Spencer has shown, in his admirable system of philosophy, that pleasure is the ultimate test of all virtue, morality and right living. What we call virtue, morality and right living, are really so because they confer finally on men the greatest happiness and afford them the greatest pleasure.

If a life of vice were at once and ultimately capable of producing greater pleasures, then vice would become virtue and virtue vice. And the same principle will be found underlying the industries and arts.

Those influences and conditions which at once or finally bring forth most from any given outlay of capital and labor, are the conditions and influences which are right and proper.

Science shows here its most intimate relations to every industry. It is its peculiar province to husband all natural resources, to make the most out of every exercise of energy, to direct in the right path every budding enterprise, and to open up new possibilities and secure new achievements in every form of organized labor.

It would be, however, a great mistake to suppose that science has no other relation whatever to industries and arts aside from what is purely financial. There are indeed other true relations scarcely less important, which should be honored at least with some attention.

True science is eminently suited to diffuse general information among those actively engaged in the various industries. Anything which tends to impart useful information to those engaged in active labor, cannot fail of having an important effect on the industry itself.

To one pursuing any vocation of skill, there is danger of falling into grooves. It is sometimes hard to see beyond the confines of self-work and self-interest. That which concerns the laborer himself in the peculiar exercise of his trade, is apt to be the only thing which will excite his attention and hold his interest.

But a narrowness of view like this, is apt to beget prejudice, selfishness and bigotry. But prejudice, selfishness and bigotry react on the very force that begets them and tend to destroy both themselves and the industry they ostensibly protect.

One great function of science is to prevent such a condition. True science liberalizes and humanizes. I do not mean by science, mere dogma and pretense and hypothesis. Many condemn science without knowing what it really is. However plausible a theory may be, however strong the arguments which sustain an hypothesis, yet theory and hypothesis are not science.

I am far from denying the verisimilitude of many scientific theories and hypotheses. They may indeed prove, and often do prove, of great benefit; yet it is a great mistake to confound these with science itself—*i. e.*, as already said, the "knowledge of matter and its laws."

Science, therefore, educates and liberalizes every trade and industry and art. Its cultivation will broaden the views of the people, dispel prejudice and superstition, remove feelings of narrow sectional pride, and make the whole world akin. When science is more broadly diffused, when it permeates more thoroughly the industries of the country, then there will be an end of humbugs and crazes, of isms and oddities, and the reign of common sense will supersede the reign of impulse and ignorance.

I understand perfectly well, as already mentioned, that it is quite impossible that every artisan should receive a complete scientific schooling. However desirable such a thing may be, it is too Utopian to be considered here. Every farmer of the future will not be a graduate of an agricultural college, no matter if they be made as numerous as high schools. But every farmer may feel the liberalizing power of scientific knowledge, and doubtless will feel it, although he may be unconscious of it. He can-

not shut his eyes to the light which is abroad in the land. The lowliest slave will feel the warmth of the sun's rays, though he may not know that the sun's atmosphere contains sodium vapor. And thus it is with all kinds of scientific knowledge. Science will warm and vivify the whole world, though many may remain unconscious of the source of the new life which springs up within them.

No one can calculate the ponderous power for good which such influences will exert and do exert on the industries of the land, and that, too, aside from any idea of increased monetary value.

Science, while it reveals the constitution of matter and makes known the laws of its change, inculcates at the same time a love and reverence for the truth. No one can study carefully the inviolable verities of nature without realizing that truth is the only thing which can endure.

Science can neither be cajoled, threatened nor bribed. Science never lies and is never deceived by a lie. No boy can go through with the simplest exercise in chemical quantitative analysis, and not have his moral nature strengthened thereby. Reverence for the truth, hatred of error; these are two ideas which are always uppermost in the scientific mind. While, therefore, science spreads information, it also teaches morality. When every industry and art are fully imbued with these two ideas they will not only attain their maximum value as wealth-producers, but also become the most potent factors of happiness-making in the world. And every one wishes to see this. Honest industries, skilled arts, honest laborers, skilled artisans; these are the pride and the salvation of the country.

I have not time to discuss this subject further. At the very beginning I was oppressed with the thought that in one short essay I could not more than make a fair introduction of the subject. I repeat the thought in closing with which I began: Science is the mother of industries and arts. She is the mother who brings them forth, and it is always parthenogenesis. She is the mother who protects them in the years of their helpless infancy. She is the mother who instructs them in knowledge and morality, and finally she is the mother who looks upon their successes with loving pride.

With such influences working on our industries and arts, the future seems bright with near possibilities. We see our industries vivified with new life and new usefulness. We see them liberalized and educated. We see them permeated with love of truth and morality. We see them feeding hundreds of millions of people at home, and covering the seas with their products. We see homes made happier and life made easier to the millions of toilers. Labor is no longer a mere drudgery, but a constant pleasure. Knowledge and industry will march hand in hand to higher usefulness and higher attainment, and in these happy results we will see realized in all the intimacy of their kinship, the "true relations of science to the industries and arts."

Commissioner LORING. Mr. President, when I suggested to Professor Wiley that he prepare the paper he has just read, I was under the impression that those of us who believe in practical men are a little apt, perhaps, to be misled in two ways: first, by the dogmas of the scientists themselves; and secondly, by those who have made statements which they considered they had proved as scientific men. I felt that the practical farmer might possibly lose his respect for the careful investigations of science through being misled somewhat, now and then, by gentlemen of his own profession, who assume that every fact they discover and lay down is naturally a scientific fact, and that every deduction from an accumulation of those facts, whether they hang together or not, was a scientific conclusion. I thought I had discovered a disposition, perhaps not general, but in certain quarters, to use an accumulation of non-essential facts, facts which either singly or in groups, apparently proved nothing, and the accumulation of which simply inspired respect because they were an accumulation, but from which no practical deduction could be drawn. This suggested to me that it would be a capital thing for a gentleman of scientific attainments, as I knew Professor Wiley to be, to endeavor to bring to our minds exactly what he has presented. A respect for thorough, sound, practical science has an elevating, enlightening and improving power in a community, not only on account of the skill it exercises in the investigation of practical questions, but also by reason of the educational influences it can exercise to elevate the mind of man out of that sphere or condi-

tion into which he is liable to be misled. An individual comes to me and says he has fed cows on turnips one month, on potatoes another month, on ensilage another month, cotton-seed meal yet another month, and on hay alone still another month, and he is satisfied on the whole, from the observations he has made on these cows while that feeding process was going on, that there is a vast difference in the nutritive qualities of those varieties of food, and that the milk itself is governed by them. He states a proposition which he thinks is a scientific one, and when he does this, I only wish him to understand that he has entered no further into the scientific reasons for that result than has the boy who gets up in the early morning by the light of the stars and goes out to water and fodder those cattle. That is the difficulty which, as I think, we are laboring under all the time. All the vast mass of discoveries, which are simply facts brought out by observation and without the slightest importance, are huddled together, and scientific men and non-scientific men, theologians and non-theologians, farmers and professors, are called upon to stand in awe and wonder before the great conclusions that have been reached. Now I, for one, when a point is presented to me as the result of scientific investigation, desire to know all the processes by which it has been reached. I believe that scientific investigation has many sides, and certainly I do not think that Professor Wiley will claim that science always discovers. There is a kind which proves and does not discover. My impression is that all of Darwin's scientific investigations proved as well as discovered; that is, he had the power of accumulating facts which tended toward a certain purpose—facts which, when read, are so familiar to every observer of natural history that we wonder we are not all Darwins—and the application of facts to establish certain theories, which he considered of vast importance to an intelligent race, is just exactly what constituted his scientific investigation or discovery.

Now that is one form of scientific investigation; that is the form which made Agassiz great. He accumulated all his facts from the intelligent men about him. I have seen him sit by the hour and inquire into all the processes of animal-breeding in vogue by the breeders themselves. He studied with the utmost care all the processes by which the short-horn family was developed in England. He spent his time and all his vast powers of mind—his immense powers—to analyze and combine in ascertaining what were the laws in nature by which that wonderful breed of animal was created. I have taken him into the presence of Mr. Hammond, of Vermont, who founded that family of American merino sheep, and who, by the application of precisely the same rules of all the great breeders, produced the American merino, of fine form, enormous clip of wool and admirable conformation generally, out of a half dozen little inferior animals which he combined with those of pure blood purchased in Connecticut, and had driven to his own farm in Vermont. With these, in midwinter, he developed that admirable animal which, possibly more than any other in America, combines valuable food and property. I have seen him sitting by the side of one of the first breeders of horses in the State of Maine, discussing the processes of some certain result which had been brought about. He has stood in my own stables and barns studying embryology. I fed 100 sheep one winter for him, in order that he might study the processes, stage by stage, and the results were furnished him. He did not take the chaff with the wheat, however. He knew enough to get that out before he used it. He took the sound grains that were presented and left it for us, with less powers than his, to draw our science from the chaff, while he drew

his from the grain. I advise farmers everywhere in this country to avoid that snag. Let us find out the facts we are dealing with, and ascertain if they are entitled to any consideration whatever.

This form of science to which I have alluded is most valuable to scientific investigation itself. That there is an inventive and creative science nobody doubts. I suppose that no accidental discoverer, no man who had not studied the laws of electricity patiently and deliberately year after year, would ever have discovered the electric telegraph. Morse was an electrician. He was an artist, it is true, for that was his profession; but he studied the laws of electricity thoroughly and perfectly, and carefully as Newton ever studied the laws that sustained him in his investigations. The result was the invention of the telegraph.

Mr. Bell came to the town where I reside (Salem, Mass.), the teacher of a little deaf-mute boy, a son of a friend of mine. He came there to teach the boy what is called "visible speech" in contradistinction to mere sign speaking. He went on step by step until he succeeded in accomplishing what has been accomplished in modern times, not only by himself but by others, the creation of a power in a human form that never heard one sound uttered on earth, to utter words. Little by little he went on, guided by his own theory, until that child was enabled to say "mother" to his mother and "father" to his father. That was the study in which Mr. Bell was engaged. During all this time he was a careful observer of all mechanical and electrical forces. It occurred to him there was some power that could be transmitted by the vibrations, so to speak, of the products of matter one upon the other. By and by he sent for me to come and see him. He had a box at one end of his room and one at the other. He whispered into the one and you could hear it in the other. Step by step he progressed, until at last he discovered he could extend that wire, and one evening he requested two hundred of us to meet him in the Lyceum Hall, the first erected in this country, and where such scholars and orators as Ralph Waldo Emerson, Wendell Phillips, and Oliver Wendell Holmes have assembled their admiring audiences. We were invited there to see and hear Mr. Bell converse with a friend in Boston, a gentleman who had been helping him in his investigations. Mr. Bell went to the box and said, "Mr. Watson," and Mr. Watson replied, "What, sir?" and it sounded as if it were a voice far away off in a cave. Mr. Watson was asked if it rained in Boston, and he replied that it did not. By and by he sang "Auld Lang Syne," and the audience laughed. The good old song came out of that little box wrapped in such mystery that had there been angels instead of witches in Salem, those present would have thought they heard the angels singing. [Laughter.] This is what Mr. Bell did, and out of it has grown this marvelous invention by which millions of fathers can converse with their children, and the children with their fathers, by which all local messages of business are transmitted, and by which the grocer in my town is put into such immediate connection with my dining room that there is no need to have any failures there. This is what Mr. Bell accomplished simply by taking the facts which he himself had witnessed and applying his inventive genius to them.

These two examples fairly illustrate the motive power of science, not the vague power of simply ascertaining how great laws are laid down, but the inventive power. And so I think you will agree with me that science performs the wonderful double process of discovering laws and inventing great processes. When we, as farmers, realize all this, I think we can appreciate precisely the position which science holds to us and which we ought to hold to it.

A practical, sensible farmer engaged in his work on his farm, while he may not possibly be able to discover the scientific laws by which work is done and the natural processes going on around him, can, if he keep his mind open, discover the facts and place them side by side so as to govern him in his operations. He should be, therefore, an investigator, and in no manner or way an advocate.

I do not wish a man to sit down before my fireside and insist, hour after hour, that a certain kind of food is good for my horses or cattle, or that the chemical analysis of my corn crop indicates that the soil is insufficient in some essential qualities. I have not time to listen to that. I do not desire him to advocate theories; I want him to assume the risks, and tell me why certain phenomena have occurred on my farm. Meanwhile, what can I show him? What can I show you, sir, an intelligent scientific observer, as to the work of myself and my kind? Why, it is the practical farmer or horticulturist who has by his ingenuity superadded to all the fruits, plants, and grasses which nourish men and animals alike. It is the practical horticulturist who has so hybridized the various plants that all their curious and interesting phenomena are developed, and the many varieties of crops that we have are the result of that investigation at the hands, not of scientists, but men whose boast is that they are practical horticulturists. It is the practical farmer who, by a certain sort of investigation, has discovered what is the lay of the land, and what is best for his crops. You can no more mislead him by chemical analysis than you can divert one of the birds of the air from its annual flight as the seasons go by, simply because he has kept his eyes open and learned what is best for him. It is the practical farmer who has taught mankind how to handle, raise and manipulate the crops, and absolutely unfolded nature—in a blind way, it is true—but so unfolded as to open a volume for the scientist to read for his own edification and for the benefit thereafter of other men.

This is what the practical farmer has done, and I am often reminded, in considering the relationship held by science to agriculture, of the sort of double relation to which I have alluded, of that delightful little story told by Bulwer in one of his essays in regard to the increase of a crop of grapes in England. Mr. Jones was perhaps the name of the quiet landholder who had an admirable grape-house, and whose grapes were esteemed in all the country round about. He had a fame unrivaled in that region, and his green-house was visited by everybody to ascertain how these crops were produced. Lord somebody or other failed in his grapes. He had an extensive garden, but year after year his grapes were worthless and his flowers were worse than his grapes. One day he visited this humble fellow-citizen of his—he called him a fellow-citizen—and admired his grapes, flowers and his green-house, and he said to him, "What a marvelous gardener you must have! what wages do you pay such a man?" And so the gentleman brought up his gardener—an humble, modest man, just passing out from youth to manhood—and the nobleman said to him, "Why, your work is marvelous, sir! What a fine scientific education you must have had to produce such grapes and flowers as these! Pray tell me at what college you were educated—where were you graduated?" And the young gardener, who was very bashful, said, "Why, may it please your lordship, I never graduated at all, and my flowers and my grapes are simply an application of what I have heard. I was caught one night in the mews of London in a rain storm, and I sought shelter in the mews. As I stood there, two men came in beside me to get out of the rain, and one said to the other, 'Charcoal will produce good grapes and give great richness to flowers.'

It occurred to me that it would be a good thing to try charcoal, and I came home and tried it. This is the result of a conversation that I overheard in the mews on a rainy night." Thereupon the nobleman went home and summoned his high-salaried gardener, and wanted to know what he meant by neglecting the great scientific laws that his humble neighbor had so acceptably applied. And the learned gardener said, "Why, may it please your lordship, every gardener knows that charcoal is beneficial to plant growth." "Knows it," said his lordship; "why didn't you apply it, then? You may know as much as you please, but if you don't apply it for me, it will be of no avail."

Now that is the operation, and is an admirable illustration, as I have always thought, of what was real, sound, good science. The farmer, cultivator, cattle-breeder, sheep-breeder, and every man who is engaged in investigating the affairs of life, contribute their share to it.

I remember a somewhat more familiar story in my own neighborhood of Essex County, Massachusetts, one of the oldest counties, where pretty much everything started from, so far as I can find out, witchcraft, and the transcendentalism of Concord and Andover. John Endicott landed there with his Pilgrims and the first meeting of the Continental Congress was held there. Now, in that county lived a gentleman by the name of Parsons, a brother of the great chief justice of Massachusetts, and while the latter was earning high reputation on the bench, Graham Parsons was plowing the high seas, and he plowed them to great profit, as did all our ancestors. They did not want any free ships then. Then he took to farming and erected a great barn; and he built great stone walls, seven feet high and four feet wide at the top. He bought short-horned cattle and undertook to keep them on rock pasture. That was part of his scientific farming. And on he went, until he found that his neighbor, Mrs. Coleman, was making better cheese than he. She would go to every Fair and always received the premium for her cheeses, while Mr. Graham Parsons had no show whatever. At last he went to Mrs. Coleman, and asked her how in the world it was she got her premium cheeses. She told his dairywoman how it came, but still he did not get a premium. He was disgusted, but tried again, and again he lost the premium. Finally he went to his neighbor and said, "I want to know exactly how you do it. Do you get a certain temperature in your milk?" "Yes, sir, I do," answered Mrs. Coleman. Parsons went over to Boston and bought a thermometer. He tried his thermometer, but still he failed in getting the premium and then went again to Mrs. Coleman. "I have bought a thermometer," said he. "A 'mometer," said Mrs. Coleman; "what's a 'mometer?" "It is an instrument to tell the temperature; how do you find out what is the right temperature for your milk?" "Laws!" said she, "I stick my finger in it."

Now, that is exactly what the farmer has to carry with him, and exactly what the scientific gentlemen must recognize—sound, solid, fundamental sense, applicable to the affairs of life.

A DELEGATE. In other words, put their fingers in it!

Commissioner LORING. Yes. That is precisely the law which has been adopted by all those who have made great inventions and great discoveries for our profession; men who found out where wheat would grow and where it would not grow—a scientific application of important facts lying right before their eyes.

When the people of the State of Iowa ascertained that it was no longer profitable to raise wheat on their broad lands, they did not swear they would raise wheat anyhow. They turned their attention to another

branch of farming—the dairy farming; and the dairy herds in the State of Iowa increased from 300,000 to nearly 1,000,000 head in ten years. That is what I call sound, practical, scientific application, and the result of that observation of facts which every good scientist always adopts when he proceeds with his investigation—that character of observation which made Lord Bacon the leader in all simple science; which made Agassiz foremost in his day in sound science; which made Darwin great; which made John Johnson, of New York, the pioneer in this country in the matter of thorough drainage, and which taught so many of the leaders in the science of practical agriculture in this country to apply those facts that were valuable and reject those which were worthless. It seems to me that we can learn a lesson from this, since in that way and in no other can we bind the science of this country as farmers, so that all over our fields we may see the effect of the careful scientific investigation made by those in whom we place most implicit confidence.

This is the kind of work that I believe will be most surely followed by our agricultural colleges. I watch with profound interest the uprising, the upspringing, the endowment and the foundation of those schools. I read everything with regard to the experiment of these colleges. I continually study their prosperity and growth, and wonder at the obstacles that stand in their way. If there be an experiment station for scientific purposes, I am with that experiment station; but I am not with the experiment station that will insist upon an accumulation of theories without any account of facts, no matter whether useful or otherwise.

The great scientific work of this country will travel the track I have suggested, and in that way I am sure we shall ultimately come to understand what are the crops best adapted to our soil, not only in the traditionary or blind way, but as the result of carefully applied tests.

We shall know in the same way the best animals to put on certain land; we shall know where to plant certain breeds, and where not to plant them. It is an important matter to know where we can put an apple tree and get our reward, and know, too, where, if we do put an apple tree, we may expect nothing. We need to learn the laws that control all our plant growth, the crops we expect to secure from our soil, and the methods of using, selecting and breeding animals, out of which comes so large a proportion of the wealth of the American farmer.

I did not intend to take up the time of the Convention, but only expected to make a few remarks upon the interesting paper presented by Professor Wiley—a paper which, I trust, will leave its impress upon this Convention as a guide and light by which scientific investigation in this country, as applied to our own efforts at least, can be best carried out. I now surrender the floor to Professor Cook, and ask him to tell us how agricultural scientific investigation may be made constantly useful to the farmer himself. [Applause.]

Professor Cook. Mr. President, I do not feel competent to answer what you have requested, by any means. I feel the warmest interest however, in that which has been presented to this meeting, and I am confident it will meet with the approval of every person who looks at the subject. I can best illustrate what I have to say by reference to particular cases, rather than by going over the ground in general. There are a great many difficulties in bringing out the points by which science can be made useful to agriculture and advance it. We take, for instance, the case of ensilage. This subject came before our experiment station, just as it has been to others—something entirely wonderful, something new to the world—and while our chemists at the

experiment station were listening to its great advantages, they felt that there were some scientific questions to be decided before we could accept the conclusion that ensilage was the only way in which corn fodder could be prepared so that it might be used to advantage for cattle.

A DELEGATE. Will you please tell us your place?

Professor COOK. New Brunswick, New Jersey.

Professor Cook then gave the details of the experiments made at the New Jersey experimental station with reference to green-fodder corn, dried-fodder corn and ensilage, and which are included in the report of that station for 1882. These experiments, he said, showed one case in which science must guide the farmer in his practice. The following interesting debate then ensued:

Professor COOK. The work in the experiment stations is exciting an amount of activity among the farmers to an extent hardly to be appreciated by those persons who are farther away from the markets and from those stimulating influences which bring the greatest degree of activity, and also by those who are pursuing agriculture in any other of its branches. I say the influence which this work is exerting on the whole community, is of the most beneficial kind.

A DELEGATE. Mr. President, the subject is a very wide one certainly, and to be looked at in various aspects. May I ask Professor Cook one question? I think I heard him state last year that he had reduced the expense of keeping cattle from 21 to 19 cents a day. Has he made any further experiments in that direction?

Professor COOK. Yes, sir.

The DELEGATE. Will you be kind enough to state the style of food you can produce at that figure? Can you still do it?

Professor COOK. Yes, sir, I think we can. In fact, we do not use our best quality of hay. We want to market it. We use corn-stalks, which are not marketable, but still they have a nutritious quality in them. We grind them up fine by means of an improved cutter. It has a flocked wheel on the side, so that it grinds almost like corn, and then we mix that with the cheaper product, the waste from hominy, meal or the bran which can be obtained, or the waste which comes from the places where they make glucose and things of that sort. By working them together, I say, we can produce a ration which keeps up the flesh of the cattle and maintains them in condition for producing milk, and we can make a considerable saving by it. I am sorry to say that at our farm we are obliged to make it support itself. It would have been a good deal more interesting if I could have incurred the expense and still carried on experiments. We must make our produce on the farm meet expenses, by being very careful of the milk we produce from our cows. The milk is sold.

Commissioner LORING. What do you mean, Professor, by the expenses? Is your expense for labor or for the professors' salaries.

Professor COOK. No, we do not mean professorships, but all the expenses attending the experiments we make.

A DELEGATE. Do these experiments pay?

Professor COOK. Yes, sir. We pay for those fertilizers we are obliged to use, and we must do as I have said, otherwise we cannot make things meet. We do not design to have any deficiency if we can help it.

The DELEGATE. Is there any preference in the difference and variety of corn used?

Professor COOK. No, sir. Our dairymen prefer to use yellow corn. They say it makes the milk yellower; not that there is any difference in

the quality, but there is a prejudice in favor of yellow milk. I cannot tell you why it is, but they can sell yellow milk easier.

The DELEGATE. Have you tried any experiments on the different varieties of corn—its value for food?

Professor COOK. No, sir, we have not. We have analyzed a great many to see, but we took our own corn, such as grows in the center of New York, which is not of the longest grain that grows farther south.

The CHAIR. You understood the question to refer to corn as a grain. I understood it to refer to corn as a fodder crop. Does the color of the corn make any difference in that respect?

Professor COOK. I beg your pardon. No, sir; we have been trying it for two or three years, but we have not reached results which are satisfactory to us, for the reason that we have had extraordinary droughts for two years past, which have shortened it.

The DELEGATE. It has occurred to me that there might perhaps be a difference in the variety of the corn with regard to the fodder.

Professor COOK. We suppose that is so. We know that there are larger leaves on the Southern corn than on that of the North, and by analysis we know there is a little more sugar in it than in that which grows farther north. We tried it in the laboratory, and are quite sure that it is so. Now, we have had Southern corn planted.

Mr. FORD. I have farmed for a great many years in Southern New York and also some years in Maryland. I have tried to acclimate some of our New York corn here, but I have not succeeded. It did not do well. The fodder seems to be very different.

Professor COOK. Do you find it as useful for cattle as that grown in the North?

Mr. FORD. Oh, no, I could not do anything with it. In New York I used the stalk pretty near up.

Professor COOK. I am not advocating any machinery, but some person in Pennsylvania invented what we call a crusher. I do not mean to advocate machinery, but this is better than anything I have ever seen, and I was delighted to obtain it. By cutting up the corn-stalks that grow here, I will warrant, sir, that you can use the whole, so that if you get a ton of it, you have a ton of cattle fodder.

Mr. DUDLEY. Upon the point that the Professor has just mentioned, let me say that we have in our State a person who has a large dairy and who brought the matter directly into practice of feeding his cattle upon corn-stalks, the very stalks that we have been in the habit of regarding as entirely worthless—I am alluding to Isaac W. Newton—that portion of the stalk that we have heretofore regarded as worthless and have turned into our barn-yards, and into very bad manure to handle. He has a dairy of some sixty head, and carries the milk to the markets of our cities. He utilizes all of his corn-stalks and all that he can procure, and during the winter season—he has pasture for the summer season—his cattle are entirely supported upon corn-stalks cut with such a machine. And I am authorized here to say this for him, and indeed I have seen myself, that his milk is as rich and abundant as it would be possible for him to derive if he fed on clover hay.

A DELEGATE. Can the gentleman give me the cost of cutting a ton of corn-stalks?

Mr. DUDLEY. I cannot, sir. He has himself an ordinary machine which is run with two horses. Of course he has horses, and I suppose he does not value the time of the horses as anything, as you all know in the winter season there is a great deal of spare time for farmers' horses. Probably he did not estimate that in carrying on the

scientific investigation. You would have to include that. But he utilizes his corn-stalks, which before this were almost valueless. Of course, in feeding them to his cattle they would feed on the blades, but the stalk itself would not be eaten, but trampled down in the barn-yard. He cuts four or five tons in a day. I merely mention this as a practical example. He has some sixty head of cattle, principally for the purposes of milk, and I give you the result of his practice in that regard.

The DELEGATE. How many tons of corn-stalks are equal to a ton of hay?

Mr. DUDLEY. Very nearly the same, Professor Cook tells me—not quite, but pretty near it. I have not gone into the question myself practically at all. I am only giving you this practical example of using the corn-stalks. I am one of those persons who believe that, while practice is very important in everything, yet I believe in the necessity, with regard to agriculture, of having experiments. I am thoroughly convinced that agricultural experiment stations are absolutely necessary for the practical development and the advance and progress of agriculture. I shall be very glad to see the time when every State in this Union shall have established an agricultural experiment station in connection with a farm for carrying on practical field experiments. I do not believe in leaving this matter alone with the farmers. The farmers of this country, as a rule, and taking them as a whole, have not the means, nor have they the time if they had the means, of carrying on agricultural experiments properly. Nine farmers out of ten in this country have to farm so closely, they cannot afford it. They must feed and clothe their family out of the crops they raise, and they cannot afford the cost of experiment. It is a practical subject which the Government should take up; and not only the General Government, but I would be glad to see a large appropriation sufficient to establish an experiment farm and an agricultural experiment station upon it in every State, so that both might be carried on for the people of the whole State. There is no State in this Union but what would be amply able to buy a farm of sufficient size and capacity to have field experiments on a grand scale, conducted year by year for the benefit of this great industrial interest of our country.

I concur, therefore, with everything that has been said here to-day. It is the great industry which underlies all the others. No other industry can exist, flourish or be conducted profitably, without the industry of agriculture. It is a subject to which too much attention cannot be paid. I believe that money cannot be more profitably expended by governments, either federal or State, than in developing agriculture. I am one of those who conceive that agriculture is but in its infancy. In almost every other industry within the last fifty or one hundred years, great progress has been made in the matter of production. In some industries of the country the matter of production by machinery and other things, and the plans that have been brought to bear upon it, have doubled and tripled. Not so with agriculture. Agriculture, for the last hundred years, has almost stood still with respect to production. So far as machinery is concerned, in planting and gathering the crops, we have made great progress; in this essential no nation on the face of the earth has made more progress than the United States. We have our reapers, our mowers, our thrashers, and our binders, and we have machines for putting in our crop. But we have not made great and substantial progress, I contend, in the matter of production itself. We plant our crops in rotation, as our fathers did before us, and by the

aid of our fertilizers, it is possible we produce a little more. We step out a little in sorghum, and the silk industry is becoming important in my own State. Occasionally new industries are started and some prove to be profitable; but we want experiment farmers and agricultural experiment stations, with their laboratories and field experiments, to lead the farmer and tell him what to do. We ought not to ask him to carry on these experiments. He cannot afford it. But the State can afford to do much for this great industry.

I presume all of you have heard of John Bennett Lawes, of England, and probably many have visited his place. It was my good fortune to spend a day there; and if I were asked what single day or two days of my life I regarded as most interesting, and left their impress more strongly upon me than any others, I should say one was the first day that I spent at Pompeii among the ruins, and the other I passed in Rothampstead, England, with John Bennett Lawes. He came into possession, in 1834, of almost a princely fortune. He had been educated at one of the universities in England, from which he was graduated with some distinction. He resolved that he would devote much of his fortune and his time in experimental farming for the benefit of mankind. He established, in 1843, what I will call here an agricultural station, because it amounts to that—an agricultural experiment station, and he established it in a barn. His farm at Rothampstead contains about five hundred acres. I think when I visited him a few years ago he had just built a new laboratory at his own expense; perhaps not all at his own expense, but I am inclined to think he did. When I was there Mr. Gilbert was his chief or head chemist, and he had ten assistants under him on his farm of five hundred acres of ground. As I passed from field to field viewing his crops, I asked him how many hands he had employed, and he told me there were some two hundred and fifty on the five hundred acres.

I refer to this simply to show how impossible it would be for any single farmer of ordinary means to carry on such experiments as these, and I think you will agree with me in this. I shall not elaborate upon it, although it is a theme upon which I could say much more.

(Mr. Dudley then detailed certain experiments which he saw in progress at Mr. Lawes' farm.)

Professor ABBOTT. I will say a word in regard to our own farm. Our legislature provides very liberally for experiments and for our improvements, but our farm does pay somewhere from $800 to $1,200 or $1,500 towards the running expenses of the institution. To return to the question before us, I fear that if we had a John Benett Lawes in this country, instead of making an experimental station, he would build an astronomical observatory. I met here in Washington, in 1872, while attending a similar Convention to this, a very wealthy gentleman who was looking for some place to "do good," as he said, with a share of his large property, and he was very much interested in agriculture. He held a commission from the governor of a State not far distant, relative, I think, to some investigation into cattle diseases, and yet when he was looking around to see what he could do for some college or institution, he proposed to build another astronomical observatory. That is the place where man would go for fame, but not to an agricultural institution. Mr. Lawes, to be sure, has within the past year or so been made a baronet, for which we all greatly rejoice. Strange to say, there is a little reluctance among some of the best farmers toward accepting science as taught at the agricultural college. They are very generous toward us, but after all we find a man sending a son to college who could not meas

ure a pint with any kind of vessel, and yet he does not want that son taught geometry. He also finds objection to the long, thorough drill in chemistry. He would like agricultural chemistry taught *at once*, and manifests no interest in the long, powerful, scientific drill which the members of our college faculty feel to be essential to any true science and essential to any true application of science to agriculture.

Mr. HOLMES, of North Carolina. I think the points brought out in the essay by Professor Wiley and the remarks by Professor Cook are very important. I believe they would help the farmer to appreciate the value of such scientific work, and lead him to liberally support the institutions where it is carried on. There is the one difficulty, however, in connection with my own station. Farmers cannot be made to see the importance of these matters; they cannot be made to see the need of having scientists. They seem to look upon chemistry as a sort of a girl's study. In 1877 the experimental station took in hand the question of fraudulent fertilizers. At that time there were no reliable fertilizers sold in the State, and the majority of our farmers had but little more use for chemistry than for algebra. But if you go to them to-day they will tell you that the fertilizers recommended by the State chemist are the only ones used. I state the fact only to show that farmers can be made to see and appreciate its importance, and encourage the efforts of science to help them.

Professor KNAPP, of Iowa. The thoughts presented are of great interest to me, because my mind has been running somewhat in the same direction. It has occurred to me, in trying to account for existing differences between many of the practical working farmers and the scientists, that possibly quite a portion of them has arisen through the faults of the scientists themselves. They have been largely—perhaps I ought not to state it so broadly—investigators after remote facts, while the farmers are interested in the facts with which they are immediately surrounded. For instance, instruction in economic botany—a science that surrounds them—would be of very great benefit to practical farmers, but the farmers do not want the economic botany of the tropics; they need the economic botany of their own State. Now if we take an investigator like Kedzie, or Barnard, and let him go to the practical farmer and undertake to investigate, that farmer will at once express sympathy in the work and manifest interest in the scientist and his labors.

Another point to which I wish to refer concerns these experimental stations. We will take the single item of corn-stalks. I have wanted to know how much it cost to cut them, because, while I have followed a line of investigation to find their value to some extent, I have also found the cost of cutting stood in my way, for we are able to produce the best clover hay at an average cost of $3 a ton. Here is where the economic question comes in.

Mr. DUDLEY. Where is that?

Professor KNAPP. In Iowa.

(Professor Knapp then continued in a lengthy argument, showing the importance to the State of Iowa of utilizing her corn-stalks. "It would," he said, "be a saving of many millions of dollars to the State if we could save the crumbs which fall from the rich man's table, and my State would even consent to become a second Lazarus if it could gather them all in.")

Mr. WARFIELD. How many tons, Professor Cook, can you raise of dry fodder from an acre, and how many tons of clover hay?

Professor COOK. Five to seven tons of dry corn-stalks, when you raise it as corn fodder.

Mr. WARFIELD. And about a ton and half of clover?

Professor COOK. A ton and a half or two tons.

Mr. WARFIELD. If you say that a ton of dry fodder is only equal to a ton of clover hay, then you are getting about seven times as much fodder as you are getting from hay.

Professor COOK. Two or three times as much.

A DELEGATE. Four or five times as much?

Professor COOK. Yes, sir. It may not be any special advantage if we only cut a certain amount of fodder, but it increases our capacity to maintain stock, and the more stock we keep so much more manure we can get, and so much better we can keep our land.

A DELEGATE. You did not tell the difference between green fodder and dry fodder.

Another DELEGATE. Did you look for the amount of green and of dry fodder that you can get from an acre of land?

Professor COOK. Yes, sir.

The DELEGATE. Did your account balance there?

Professor COOK. We found that the green corn fodder was almost three-fourths water. I think it took almost 400 pounds of green corn fodder to make 100 pounds of the dry, so that when we took 20 tons, it would be only equal to about 5 tons of dry.

The DELEGATE. In other words, your 15 tons of ensilage did not produce more than 5 tons of dry fodder.

Professor COOK. No, sir; it did not produce quite so much.

A DELEGATE. Mr. President, to test the feeling of members of the convention in regard to further meeting, I would move that hereafter this convention meet at 10 and at 2 o'clock, with a recess of an hour at least between. I move this for this reason: I noticed that when one gentleman was reading his essay, a good many were compelled to be somewhat discourteous, going out to lunch. I move that these be the hours of our meetings hereafter.

The motion was agreed to.

Mr. ATHERTON. I am requested by Mr. Kuleshoff to ask Professor Cook if he directed his experiments simply towards growing corn or corn fodder? Are we to understand that the product that you have been testing with ensilage, is corn grown without the ear, or with the ear?

Professor COOK. We tried it both ways, when it was grown especially for corn fodder and otherwise, and we have also tried it with corn-husks.

Professor RICHARDSON. I would like to call attention to the fact that if you utilize the stalks after the corn has been taken you lose the leaves, which at that time contain all that portion of valuable nitrogenous substance. If, therefore, the corn is included, you get a much richer product, and that ought to be taken into consideration. They are not as valuable as the stalks bearing the leaves.

* * * * * * *

[The discussion upon the value of ensilage, methods of preparing it, expense, &c., was continued throughout the afternoon, being participated in by several members.]

Commissioner LORING. The question which opened the discussion was the paper by Professor Wiley upon "the true relation of science to the industries and arts." I have watched the debate with great interest to see how it gradually floated away from the subject until ques-

tions of economy became mixed with questions of scientific investigation. This is a difficulty liable to occur. We made an attempt to define what science would do for us, and for some reason we naturally ran into a discussion relative to the precise economic application of the various processes of farming. We have heard one system talked of this afternoon, which really shows how valuable is this application of science. I learned from experiments many years ago, that a crop of corn raised to feed green to my cattle was worthless, and I said so over and over again. I stated that fodder corn, as grown, was an immature plant, that it was not thoroughly nutritious so far as we knew, and that it must reach a stage nearer maturity in order to make it valuable as food to the animal kingdom. I will believe anything that chemistry shows, provided my cattle approve of it. When they have opened the way, that is enough. Why not take the approval of the cattle anyway?

If we can utilize science where it will settle certain muddled questions, we have done immensely for it and it for us; and we shall find that some time in the course of the longest life, some one practical, agricultural question will be settled beyond dispute. Do you know of one now? I do not think of one. It is because we will not accept the conclusions of science, even after it is called in to show its true relations by ascertaining or placing on a scientific basis that which we have discovered in our practical work.

With regard to economic questions, they are totally different things. You cannot establish a rule here as to whether a man shall raise corn or fodder corn. I plant my corn crop on the last of May. I do not plant any, but suppose that to be the case. That crop has no more connection with what a crop of fodder corn should do for me than the sugar crop of Louisiana. It begins to ripen in September. It has to be topped and shocked, and whenever the grain is ripe, the fodder of that crop of corn has been vastly reduced in amount. You top your stocks as we used to do in old times, and you have reduced your crop of corn fodder so much. Then your topped corn stands in the field until the corn is ripe, and every man, woman, and child in New England knows it is not worth half price for any purpose. The leaves are well enough, but the butts are about as near worthless as anything possibly can be, next to a birch stalk. You get your winter corn, but meanwhile your cows are looking for something to eat, and the season when you are obliged to feed fodder corn, has passed. And so you have been endeavoring to compare two crops that have no more relation to each other than potatoes and cabbages. That is the difficulty. We drift into economic questions and leave the pure abstract scientific questions to travel on another path. The question of raising corn is a matter of locality, and involves economic considerations belonging to a locality. I cannot raise corn in Massachusetts. I can buy corn from the West cheaper than I can raise it. I *can* raise sweet corn, and after I have cut that, I have something I can convert into fodder corn. But so far as the profit of the operation is concerned, every man must be allowed to judge of that for himself in his own section. If he live in Kansas, he wants his corn crop for the winter, and to convert into money. If in Massachusetts, he uses the green corn to supply the market, or else he wants his fodder corn to feed during the dry season when the cattle need it.

What has been said about silos has interested me deeply as an economic question, and the interesting chemical questions involved have let light into my mind. Valuable scientific facts have been presented by Professor Cook, but the Professor has not laid down, nor desired to lay

down those laws for Massachusetts. What is bad in New Jersey may be good in Massachusetts and Virginia.

[The Commissioner then explained what he was doing in silos on his farm, with rye and corn, and in conclusion said: "But this question of the economic manipulation of corn in a silo, is not subject to a general law. I cannot, in Massachusetts, establish a law for Kansas, nor can Kansas lay down any law to apply to my operations in Massachusetts. You must govern yourselves by your own understanding of the economic processes suited to your several localities. I think we ought to distinguish between those questions that are purely economic and those which, when we get a little lost and don't quite understand, we refer to scientific labors to settle. I have referred in this manner to the special question before us, because I wanted the scientists here to feel that they have their special province, and in this, they can be of vast service to us, while we ourselves must join with them somewhat in testing the economic processes before us."]

After some further discussion on the question of ensilage, the president announced the papers for to-morrow. He also gave notice of a meeting of the United States Agricultural Society in the library to-morrow morning from 10 to 11 o'clock, after which the Convention would resume its session.

On motion, at 4 o'clock and 20 minutes p. m., the Convention adjourned.

SECOND DAY.

WEDNESDAY MORNING, *January* 24, 1883.

The Convention was called to order at 10.22 a. m., and, in accordance with the notice given yesterday by the president, the first portion of the meeting was assigned to the United States Agricultural Society. The president of that society, Mr. John A. King, of New York, assumed the chair, and read an address.

At its conclusion, the proceedings of the Convention were as follows:

Commissioner LORING. Mr. President, the suggestion you have made with regard to co-operative fairs, is one entirely worthy of consideration. It worked well with the old society, as you know, and in order that the matter may be brought to practical and business-like solution, I move to the members of the United States Society (for there are a few of them here) that the president and the secretary of that society be appointed a committee to correspond with any State society they may select, to ascertain the practicability of holding a conjoint fair in some State during the coming season or at any future season. The secretary of the society, who took an active part in the fairs already held, is thoroughly familiar with the business of such an organization, and I can assure you he would be entirely competent to prosecute any of the business pertaining to such a work. I move, therefore, that the president and secretary of the United States Society be instructed to correspond with these State societies for the purposes to which I have alluded.

Mr. SANDERS, of Illinois. Allow me to suggest to Dr. Loring that he amend that motion slightly, and not limit it to State fair associations. In various parts of the country there are organizations for holding fairs that are not State societies, and a slight modification of the motion should be made to include those organizations, such, for instance, as at Cleve-

land, or Saint Louis, or Chicago. They are not connected with State organizations, but are doubtless far more influential than any State society. I move to amend the motion accordingly.

The motion as amended was agreed to.

Commissioner LORING. I think there is no further business, Mr. President, except, perhaps, securing additional members for the old society. That is a matter which the members of the society desire to leave entirely in the hands of those who are present, and I presume Mr. Grinnell, who is the secretary of this Convention, will be glad to receive the names of those wishing to join. I now move that we adjourn.

The motion was agreed to, and at 11 o'clock and 10 minutes the meeting adjourned, and the Convention resumed its session, Commissioner Loring, the president, in the chair.

Credentials were announced for the following-named delegates:

NEW YORK STATE AGRICULTURAL SOCIETY.—N. M. Curtis, H. E. Alvord, Gerrit S. Miller.

ILLINOIS BOARD OF AGRICULTURE.—Hon. H. G. Savage, Hon. Samuel Dysart, Hon. George S. Haskell.

VERMONT STATE AGRICULTURAL SOCIETY.—Hon. Justin S. Morrill, Hon. William W. Grout.

MARYLAND IMPROVED LIVE STOCK BREEDERS' ASSOCIATION.—Alex. M. Fulford.

Thereupon, Hon. D. WYATT AIKEN was introduced, and read the following paper:

THE GRANGE—ITS ORIGIN, PROGRESS, AND PURPOSES.

By Hon. D. WYATT AIKEN.

Mr. PRESIDENT: The term "Agricultural Education," selected by you as one of the topics for discussion during this Convention, is to my mind indefinable. He who has acquired much knowledge by reading is universally conceded to be an educated man, and such an one may have gathered from books a vast deal of agricultural knowledge, but if he knows little or nothing of the practical application of the many sciences comprehended under the word "agriculture," this Convention, at least, would not accord to him an "agricultural education."

On the other hand, hosts of farmers without education, agricultural or otherwise, have attained success in life by applying sound common sense and good judgment to the execution of their plans. Hence, I say the term "agricultural education" is indefinable.

Possibly some of the agricultural colleges of the States of the Union are to-day imparting this species of education to their students, where they have a curriculum for the open field, as well as a curriculum for the school-room; for surely he is acquiring an "agricultural education" who learns the science in the laboratory and immediately applies it upon the farm. But if such a thing is done at the present time it must be of recent origin, for anterior to 1877 it was a misnomer to call any institution in the United States an agricultural college. Grant, however, that such an education is imparted by our agricultural colleges, it is only to the sons of farmers, and not to farmers themselves, for to most of these latter there were no such times as college days. But it is of the farmers' school I desire to speak—of the Grange—the school-room of the Patrons of Husbandry, where the farmers with their wives and children meet together upon a common footing, "with every barrier to social intercourse thrown aside," and there endeavor to balance exhaustive labor by instructive social amusements, or attempt to communicate knowledge upon every conceivable subject that pertains to the farm. Upon the origin, progress, and purposes of this organization I now propose to submit a few thoughts.

The Order of the Patrons of Husbandry is still in its minority, if measured by the standard of a human life-time, and yet its birth and infancy are shrouded behind a palpable veiling of doubt as impenetrable as if it had emerged from the darkness and gloom of the middle ages. Its founders are well known, and are all living; but just how much of the structure each one framed or erected, they themselves are unable to inform us. Suffice it to say that in January, 1866, Mr. O. H. Kelly, a clerk in this Department, was sent upon a mission of some sort through the South by Mr. Newton,

the then Commissioner of Agriculture. Kelly journeyed as far south as Charleston, S. C., thence to Savannah, Mobile, New Orleans, up the Mississippi to Memphis, across the country to Atlanta, and back again to Washington City by the 21st day of April following (1867).

Impressed with the disorganization of that peculiarly agricultural section, and grieved at the utter demoralization of its people, whom he found intelligent and trustworthy beyond his anticipations, Kelly conceived the idea that for the resuscitation of the country and the recuperation of its farmers, whose wealth and resources had been swept away by the cruel hand of war, organization was a necessity. This, however, was but a transient thought as applied to the farmers of the South, for a moment's reflection convinced him that there was vital need of organization among the farmers of the Union, North as well as South, and to effect such an end became the thought of his life. He reasoned that agricultural clubs were neither permanent nor effective; they were ephemeral, and seldom, if ever, controlled by farmers. State and county fairs were not for farmers alone, but open to the competition of the world. In his soliloquy he queried, why should not farmers join in a league peculiar to themselves, in which others should not be admitted to membership? Such an union would be partisan, and if partisan it should be secret, and if secret it must have a ritual to make it effective and attractive. This process of reasoning rapidly brought him to a conclusion, and forthwith he undertook to execute the ritualistic framework of such an organization. The task was, however, beyond his capacity, and he soon found himself sounding in deep water. But Kelly was a man not easily baffled, so with ardor unabated he resorted to the expedient of advising with counselors.

Mr. J. R. Thompson, then, as now, an officer in the Treasury Department, and Mr. William M. Ireland, then chief clerk in the finance division of the Post-Office Department, to which Bureau Kelly had been transferred in the fall of 1866, were two congenial companions whose acquaintance he had made after his return from the South. They were both schooled in the mysteries of masonry, and the former was a proficient in the composition of ritualistic work. Kelly had no hesitancy in approaching these two friends. They heard his story, and indorsed his efforts, and the trio had repeated consultations upon the subject. Before making visible progress, however, the necessity arose for the counsel of a practical agriculturist.

By common consent Mr. William Saunders, then, as now, the skilled and efficient superintendent of the garden and grounds of this Department, was invited to join them, which he did with some misgivings, however, because of the comprehensiveness of the work as he appreciated it.

This quartette, unwilling to pass judgment upon the work of their own minds, invited the Rev. John Trimble, then an officer in the Treasury Department, to exercise the privilege of criticising their labors as they progressed.

After a season, the Rev. A. B. Grosh, then a clerk in the Agricultural Department, and an Odd Fellow of high repute, and Mr. F. M. McDowell, then as now a vineyardist of Wayne, N. Y., and a friend of Mr. Saunders, were induced to labor with the five, and these seven constituted the immortal founders of the Order of the Patrons of Husbandry, though several mutual friends now unknown to the order were at sundry times consulted, and suggested much that was valued, but a vast deal more that was rejected.

For nearly two years these seven men wrought with an energy unaccountable, and with a faith amounting almost to inspiration, until they completed a well-devised scheme of organization, based upon a ritual of four degrees for men and four for women, unsurpassed, in my judgment, in the English language for originality of thought, beauty of diction, and purity of sentiment. Having framed a constitution, adapted to this ritual, to govern them, these men met on the 4th day of December, 1867, in the little brown building now standing embowered in the trees on the corner of Four-and-a-half street and Missouri avenue in this city, which was at that time the office of Mr. Saunders, and then and there constituted themselves the *National* Grange of the Patrons of Husbandry, with Saunders as master, Thompson as lecturer, Ireland as treasurer, and Kelly as secretary; the remaining offices left vacant.

What a conception, that seven comparatively humble and unambitious men should presume to style themselves a *National* organization! Was this presumption, was it fanaticism, or was it inspiration?

During the four years next succeeding, their zeal was nothing abated. Their time, their labor, and their scanty cash were all cheerfully given to scatter the seeds of promise far and wide over the Union, for they fervently believed they were casting their bread upon the waters. As an evidence of their faith and enthusiasm, Kelly resigned his clerkship and embarked upon a pilgrimage among unknown farmers in the Northwest, taking with him neither scrip nor money, for he had neither, and his comrades had none to advance him. The only letter of credit furnished him was a sort of "to all whom it may concern" epistle, which perchance might be of service to him if he met an acquaintance or friend of either of the seven. They buoyed him,

however, upon the eve of his departure with a fraternal "God bless you and your efforts, Kelly."

Was there ever a better display of self-reliance and fortitude? Kelly had pluck and his comrades confidence, so he went on his way rejoicing. Kelly was scarcely a success, however, as an evangelist, for he organized but one grange at Harrisburg, Pa.; one at Fredonia, N. Y.; one at Columbus, Ohio, and perhaps one or two others on his way to Northern Minnesota, chiefly in cities where farmers are not wont to congregate to do farm work, and arrived at his former home without a penny in his pocket, his traveling expenses having consumed the charter fee of fifteen dollars, which he received from each grange organized. Meanwhile, his co-laborers in Washington were printing and distributing circulars declarative of their object, were issuing copies of their constitution, were printing manuals containing the ritual, and frequently were so destitute of funds that they were unable to pay the postage upon the printed matter they wished to distribute.

In those days the franking privilege was a boon granted for the asking, but never in any instance was this favor requested for a single parcel, nor were alms ever at any time solicited to further their laudable efforts.

During these four years this septuary brotherhood met frequently, and formally once in each year as the National Grange. There is no recorded evidence that a quorum was always present, even at their annual meetings; indeed, quite the contrary is easily proven, for at the third annual session of the National Grange, Worthy Master Saunders, with marked dignity, delivered his inaugural in the presence of Secretary Kelly, his entire auditory, and when he concluded, asked leave to print in the next morning's daily papers, that the two might buy a few extra copies each, and thus be enabled to circulate their proceedings. Of course leave was granted. The printing was done, and two hundred copies of the morning paper were purchased and distributed at private expense. But the National Grange preserved its dignity, and the founders reasserted their faith in its perpetuity; a confidence amounting almost to prescience.

The constitution of the order required that every subordinate grange should be composed of at least nine men and four women, and that fifteen such granges might apply for the organization of a State grange. In accordance with these provisions, a State grange was organized in Minnesota on the 23d day of February, 1869, and another in Iowa on the 12th day of January, 1871. On the 3d day of January, 1872, the National Grange met in its fifth annual session, and as an accession to its members hailed with a welcome the presence of Dudley W. Adams, the master of the State grange of Iowa, and the first member of the order who had ever met with the original seven.

Prior to Kelly's missionary excursion to the Northwest, two subordinate granges had been organized in Washington City, of good material doubtless, but scarcely such as were required by the constitution, which authorized the initiation of only such as "were engaged in agricultural pursuits." However, these two may without impropriety be said to have been rehearsal granges, in which the symmetrical fitting together of the degree work could be experimentally and satisfactorily tested.

Anterior to the fifth session of the National Grange there had been organized in the several States about two hundred granges, whose charter fees had partially reimbursed the founders the money advanced in the cause, but annual salaries had been promised the master, the secretary, and the treasurer, not a dollar of which could now be paid, for there was as yet not a surplus penny in the treasury. During the year 1872 new life was infused into the order, and before its close more than one thousand granges were organized, scattered over more than half the States of the Union.

The founders continued to work most assiduously and framed a degree peculiarly suited to the State grange, and another higher one for the National Grange, and still another for those patrons who had served twelve months or longer in the National Grange. They also appointed deputies to work in the grange field. Your humble orator was appointed "general deputy for the Southern States."

In the fall of 1872 the secretary mailed to all the masters of State granges, to the deputies, and to others who had labored for the cause, a letter of invitation to convene in Georgetown, D. C., on the 8th day of January, 1873, in the sixth annual session of the National Grange. Seventeen delegates, representing eleven States, assembled on that day at the place designated, six of whom were masters of State granges, and the remainder deputies in the order. In addition to these, four ladies honored the body with their presence, and now for the first time in its history the National Grange began to assume the proportions of a national organization. The long-cherished hopes of the founders were about to be realized. The American farmers were at last aroused from their lethargy, and expressed a willingness to combine together for their mutual benefit and protection. And to accelerate so glorious a consummation, these noble founders, with a magnanimity equaled only by their sincerity, relinquished their claim to this admirably devised system of organization, and delivered it over with all its franchises—its organic law, its ritual, and the accumulated results

of six years of laborious work—as a gratuity to the National Grange as constituted at this its sixth annual session.

Scarcely had acknowledgments been returned for the donation, before the keen blade of revision was thrust into its organic law, and many of its patriarchal features rejected, and provisions inserted more in accordance with the spirit of our republican institutions. Every one present was allowed to vote, and the State of Iowa was accorded five votes, a preponderance she held in the National Grange for several years afterwards.

The sixth session continued for four days, and before adjournment the foundation was laid for active, energetic, progressive work during the succeeding year. The enthusiasm of the founders was imbibed by every delegate present, and each avowed himself a propagandist on his return home. To date there had been organized more than thirteen hundred granges, more than half of which were in the two States of Iowa and South Carolina. No valid reason was entertained why a majority of the States should not each possess as many as then existed in these two combined. A little more than twenty-one thousand dollars ($21,090) had been received by the treasurer, and expended in distributing circulars, printing manuals and constitutions, and in paying off old debts to the satisfaction of the Grange. But there still remained a debt of $6,000 due as salaries, which it was then resolved should be liquidated, though the treasury had been exhausted. Everything worked in perfect harmony, and the labors of the session were closed by the institution of a brotherhood as fraternal as the ties of Masonry, and as binding as the fellowship of the Christian Church. Great prosperity hovered in sight. Hope became confidence, and perseverance a labor of love. "Organize," "organize," "organize," was now the shibboleth of the American farmer. Wherefore? cried the perplexed observer. His inquiry was answered by any and all farmers, who assigned as many reasons for the necessity of organization as there were grievances, fancied and real, and of both there were legions. Yet, with all, there was no well-defined general or individual purpose in view among the mass of farmers, save that of organization. It was a partisan affair, and it was secret, and therefore if correctly managed could not fail to benefit the membership. So said the interested parties, without properly appreciating much that was designed by the founders. The delegates to the sixth session of the National Grange themselves entertained but crude ideas of the prospects of the growth and development of the order, as was evinced by the speech of Brother T. R. Allen, of Missouri, in which, just before adjournment, he besought the Grange with tears in his eyes to meet twelve months hence in Saint Louis, pledging them his utmost efforts to greet them with one hundred granges. His appeal was heeded. Saint Louis was chosen as the place of meeting in 1874, and when the National Grange assembled there they received the joyous news that there were over fourteen hundred live, active subordinate granges in the State of Missouri alone.

The years 1873 and 1874 were marvelously prosperous years for the Grange. In the former, eight thousand six hundred and sixty-eight subordinate granges were organized; and in the latter, eleven thousand nine hundred and forty-one.

Then it was that in our strength we exposed our weakness; our debts had been paid, and our coffers were full. But we had grown suddenly too rich and powerful. We had leaped from poverty into affluence. From a struggling brotherhood of seven we had developed with magic growth into a fraternity of over twenty thousand subordinate granges, averaging a membership of forty, all adults, or well-grown male and female youths, and our numbers were increasing at the rate of thousands a month. But our ranks lacked discipline. Our leaders were afraid of the multitude, and chaos prevailed to a considerable extent throughout the order.

At the Saint Louis session in February, 1874, the National Grange issued its first "Declaration of Purposes," a portion of which read as follows:

"We shall endeavor to advance our cause by laboring to accomplish the following objects:

"To develop a better and higher manhood and womanhood among ourselves. To enhance the comforts and attractions of our homes, and strengthen our attachments to our pursuits. To foster mutual understanding and co-operation. To mantain inviolate our laws and to emulate each other in labor, to hasten the good time coming. To reduce our expenses, both individual and corporate. To buy less and produce more, in order to make our farms self-sustaining. To diversify our crops, and crop no more than we can cultivate. To condense the weight of our exports, selling less in the bushel and more on hoof and in fleece; less in lint and more in warp and woof. To systematize our work, and calculate intelligently on probabilities. To discountenance the credit system, the mortgage system, the fashion system, and every other system tending to prodigality and bankruptcy.

"We propose meeting together, talking together, working together, buying together, selling together, and, in general, acting together for our mutual protection and advancement, as occasion may require. We shall avoid litigation as much as possible

by arbitration in the Grange. We shall constantly strive to secure entire harmony, good will, vital brotherhood among ourselves, and to make our order perpetual. We shall earnestly endeavor to suppress personal, local, sectional, and national prejudices, all unhealthy rivalry, all selfish ambition. Faithful adherence to these principles will insure our mental, moral, social, and material advancement."

At the same time they declared it to be their purpose to bring consumer and producer together; to wage no warfare upon any other interest; to advance the cause of education among the brotherhood and for their children by all the means in their power; to destroy sectionalism, and, last but not least, to inculcate a proper appreciation of the abilities and sphere of woman.

At this session thirty-two States were represented; twelve of them by the masters and their wives, and twenty of them by the masters alone; also one Territory, by the master.

Early in this season of prosperity we were called upon to prove in a most practical manner many of the purposes to which we had given a declaration. The grasshopper plague of the Northwest appeared to be a mysterious Providence sent to test our sincerity. And scarce had we the time to verify our faith by our works, before the Father of Waters deluged the Southwest and subjected us to a further test. Appeals for subsistence came, but not in vain, from our brethren in both those sections; over twenty thousand dollars were taken from our treasury and invested in breadstuffs, provisions, and planting-seed, which were shipped, freight prepaid (and in many instances no freight was charged either by boat or railroad), for distribution among Patrons in Iowa, Nebraska, Minnesota, Dakota, Kansas, Colorado, Missouri, Arkansas, Mississippi, Louisiana, and Alabama.

All the while our members were constantly and daily increasing, our treasury was plethoric and regularly growing fuller. But to properly appreciate the rapidity and extent, yea, the very enormity of our growth at this time, a few incidental facts may perhaps be properly related here.

For several years consecutively, as soon as practicable after the adjournment of the National Grange, thirty thousand copies of its proceedings, averaging one hundred and fifty pages each, were printed and delivered free of cost to the subordinate granges.

Miss C. A. Hall, of Minnesota, who doubtless deserves the credit of suggesting the idea of female membership in the Grange, compiled and secured the copyright of a song-book for the order, which the National Grange bought for one thousand dollars, and printed in many consecutive editions of ten thousand copies each.

The executive committee, impelled by the necessity of relieving the unlettered farmer, who might be chosen to fill the master's chair of his grange, from the embarrassment of his own ignorance, attempted to purchase the copyright of Cushing's Manual, that a copy might be placed in the hands of every subordinate master. But failing to negotiate the purchase, they compiled a "Patron's Parliamentary Guide," and circulated fifty thousand copies among the subordinate granges.

Postmasters from all the States informed us that the order had greatly increased the bulk of their mails, and one said that "there are now thirty newspapers taken at this office, whilst there was but one taken before the establishment of the Grange in this vicinity." And one clergyman wrote that "since the introduction of the Grange, I have seen a remarkable change in the walk and conversation of my flock; they are more careful in their dress and general appearance and are reading more."

From every quarter came the Grange call for books, and much money was invested in select libraries for granges in many of the States.

To every grange organized the National Grange sent a paraphernalia—a sort of equipment chest, containing materials necessary to an intelligible comprehension of the ritualistic work of the degrees; among other articles was a knife, an implement with which every *laborer* should be provided to remind him "never to break a twig or a flower, but to always cut it smoothly with a knife, so as not to injure the plant." Thus was he instructed emblematically "in his intercourse with his fellow beings to correct an error tenderly and with the smooth edge of affection, and never to bruise a wound he wished to heal." The executive committee, to procure the needed supply of these knives, visited the largest cutlery manufacturer in the United States, who, when told that we wanted ten thousand of these knives, with an expression of astonishment exclaimed, "Gentlemen, do you deal in anything but knives?"

Is it presumption to suggest that the world has never seen a better educator than the Grange? It takes care of its own, and makes them better men and better women, and wiser men and wiser women.

But additional incidents may be recited to show how others appreciated the power and influence of the order in those days of its prosperity, when it held a vantage ground for a short while, and lost it only from lack of education and discipline, perhaps never more to be fully regained.

Confidential price-lists of manufactured articles were issued to the granges, perhaps once a quarter, in small pamphlets of from eight to ten pages. A leading news-

paper in New York City proffered to print and circulate one hundred thousand copies of these price lists to the granges, if it were allowed one page for its own advertisement. The postage alone on this circulation in sealed envelopes, as the editor proposed, would have amounted to six thousand dollars, besides the paper and press-work.

A city in the West proffered a splendid building as a donation to the National Grange if they would locate their headquarters permanently within its limits. Another proposed to furnish all necessary office room free of rent, and an annuity of $5,000 for five years, for the same boon; while the city of Washington, through a company of her best citizens, only wanted to know what other cities would do, that she might "go one better" to prevent the removal of the headquarters or secretary's office.

Transportation companies seeking national legislation, Congressional lobbyists, and every imaginable enterprise that depended for its existence upon public favor, supplicatingly approached the order to secure its favorable indorsement, but without success, for the Grange, actuated solely by principle, ascended a higher plane, and rejected every approach as an insinuation that they were purchasable.

Scarcely had we grown to these huge proportions as an order before mutterings of discontent were occasionally heard like the rumbling of distant thunder, and anon a storm-cloud burst upon us, which tested the elasticity and strength of our fraternal bonds. Lack of discipline was everywhere manifest. Jealousy and envy began to crop out among the rank and file of the order, and, rising like a gaunt and bloody specter, shook their gory locks in the faces of the leaders and demanded a distribution of the funds then in the treasury of the National Grange. To appease this unreasonable demand, the faint-hearted, constituting a majority of the voting members of the National Grange, yielded to the clamor, and voted to disburse gratuitously $54,825 among the subordinate granges throughout the Union. This gave but $2 50 to each grange, a sum far too small to be of any material benefit, and therefore the aggregate expenditure of that large amount in this manner was an extravagant squandering of the funds of the National Grange.

Other causes, too, threatened discomfort to the order at that time. In the confusion of an unprecedented organization we had left the gates ajar, and designing men from every avocation of life had crept into our ranks. Men whose capital was invested in enterprises inimical to the farmer, and whose farms were perhaps their garden-plots, were received into the Grange under the plea of being interested in "agricultural pursuits." Schemes were devised for engaging in all kinds of manufactures as Patrons. Grange agencies were established in all of our cities, where the agents proposed to serve both producer and consumer, buying in the cheapest market for one, and selling in the highest market for the other, and guaranteeing satisfaction in both cases. Everybody wanted to join the Grange then; lawyers, to get clients; doctors, to get patients; merchants, to get customers; Shylocks, to get their pound of flesh; and sharpers, to catch the babes from the woods.

One grange was organized on Broadway, New York, with a membership of forty-five, representing a capital of perhaps as many millions, and composed of bank presidents, wholesale dealers, sewing-machine manufacturers, and Wall-street speculators, the only member who could lay the least claim to having an interest in agriculture being a merchant who owned a house and lot in the White Mountains, where he usually spent his summers. A similar grange was organized in Boston; and in New Jersey, near New York City, a grange was found, in fair working condition, with a general of the Army as its master, a stone-mason as its secretary, and the owner of a grain elevator as its chaplain. These wily men, of course, sapped the very foundation of the order, and rendered it almost lifeless in more States than one.

The executive committee were untiring in their efforts to counteract these depressing influences. Appreciating the completeness of the organization and comprehending the power of members, they attempted practically to execute in every way possible our "declaration of purposes." They visited the manufacturers of the United States who supplied the markets of the country with such articles as farmers needed, from a scooter plow to a six-horse engine or a parlor organ, and explained to them fully the purposes of the order, proposing to concentrate the purchases of the Grange where the greatest discount was obtained for cash, for the order countenanced no method of dealing except upon a cash basis. In no individual instance did they fail to secure a reduction of from 25 to 50 per cent. upon the article purchased. These reductions and the amount of our purchases startled the middlemen. Reapers that were selling at $275 were reduced to $175; thrashers at $300 were brought to $200; wagons that had been selling for $150 fell in price to $90; sewing-machines that commanded $75 and $100 fairly tumbled to $40 and $50. And so with every implement that came within the wants of the Patrons.

These reduced prices were secured under the seal of the grange, and were enjoined upon all members of the order as "confidential," when printed in the price-lists already alluded to. But the greed of avarice was incapable of secrecy, and covetous

Patrons, hoping to obtain still better bargains, revealed to outsiders these contracts between manufacturers and themselves, and thereby damaged both of the contracting parties. One point, however, was gained, for the reduction in price once secured was never lost.

The executive committee attempted also to inaugurate a system of crop reports, which, after a trial of only six months, proved more reliable, more expeditious, and more satisfactory than any system then in operation or since devised by the Agricultural Department of the Government. It was as follows: The subordinate granges were requested to meet as nearly as practicable on the first day of the month. There were then twenty-five thousand subordinate granges scattered throughout the Union, and located in every State but Rhode Island, which never has had a grange upon its soil. Twenty-five thousand circulars were then printed, containing questions concerning the farm and its products, with sufficient blank space for answers to these questions. One of these circulars was mailed to each subordinate grange early enough to insure its reception before the monthly meeting. Anticipating this circular, each patron went to his grange session prepared to answer as far as practicable all questions pertaining to his farm or his neighbors' farms, when the latter were not members of the order. Immediately upon the assembling of the grange each member reported to the secretary, who, after adjournment, collated and compiled these reports and transferred his aggregated result to the printed circular, which he mailed to the executive committee at Washington City. By the 15th of the month these reports, or a majority of them, were received here. A sufficient force was engaged to make a a compilation of these, which was transferred to an aggregated sheet, and this sheet at once printed, and as soon as practicable mailed to the granges, in an envelope containing another sheet of questions, so that when the grange received the consolidated report of the first circular it also received another series of questions different from the first, but all pertaining to the farm and its crops. The National Grange paid all the expenses of the system, including the postage on the replies returned from the subordinate granges. As an evidence of our expedition, we reported, on the first day of a certain month in 1874, that Pennsylvania grew more wheat per acre, and New Hampshire more corn per acre, than any other States in the Union, and thirty days thereafter the Agricultural Department of the Government reported the same facts as original discoveries. The theory of our system was perfect, but its execution was too expensive for private enterprise. More than once we were hindered in our progress by the inability of the Government to supply us with postpaid envelopes as rapidly as wanted. In those days there were no mail-carriers or city deliveries, but the post-office department of this city extended us the courtesy of sending their wagon daily to grange headquarters for our mail.

The executive committee also published for the use of the Grange a set of co-operative rules, based upon the Rochdale system of co-operation, which were greedily clutched at by the order, but were not universally utilized because of the opposition of the Grange agencies previously established upon a commission or joint-stock plan. To master the Rochdale system we procured all their publications, which brought us into communication with the co-operators of England, who became inquisitive about the Patrons of Husbandry, thus effecting a correspondence which resulted in our sending a deputy to England, who introduced the order there, and organized some subordinate granges among the farmers of that country. Subsequently the English co-operatives sent three of their best representative men to the United States, authorized to effect, if possible, a reciprocity system of exchange of products with the Patrons of Husbandry. That commission and the executive committee of the National Grange held consultations at Washington, Saint Louis, Louisville, and Atlanta, which resulted in a proposition from them that they would erect their own warehouses in New York City, Norfolk, Charleston, and New Orleans, and supply them with every article of clothing and every farm implement needed by patrons, and sell the same to patrons at a discount of ten per cent. less than the same articles of like quality could be bought for in this country, and that they would receive in exchange every variety of farm product at the ruling market price, *provided* the Patrons of Husbandry would concentrate their purchases upon the Rochdale co-operators. This proposition was not rejected from any patriotic motive, but it was not entertained because the executive committee were not competent to control the purchases or sales for a single subordinate grange.

The consequence of our efforts at co-operation was the establishment in many of the States of the Union of co-operative stores, some of which are quietly but certainly saving to-day thousands of dollars to their customers.

In its incipiency the Grange movement was not popular in many sections of the United States, even among farmers, and notably was this the case in the South. For a few years succeeding the war that people were greatly harassed by secret political associations, which had a tendency to widen the breach, if any existed, between the races. The Grange, being secret and confined to one class of citizens, was accused of introducing political machinations that augured trouble to the community; hence

many citizens, not a few of whom were farmers, discouraged its introduction. Other farmers, South as well as elsewhere in the United States, condemned the Grange as a woman's rights institution, because women were received as voting members into the Order, while thousands everywhere, with significant emphasis, exclaimed, "What do farmers want with women in a secret society?" And yet still others, of peculiar religious idiosyncrasies (and not Romanists either), set their faces against any and all secret associations of any character or for any purpose whatsoever.

There was little difficulty in removing most of these objections when an opportunity was afforded to explain the purposes of the order, for although upon the surface there appeared obstacles in the path of the organizer, there was apparent to every observant man a readiness, a willingness, yea, an anxiety in the agricultural mind of the country for organization of some sort. The Grange literally "filled the bill," for its constitution positively inhibited the discussion of political or religious subjects during its sessions; it did not ask the farmer to *send* his wife or daughter to the grange, but invited, yes, urged him to bring them, and thus protect himself against evil and vicious associations, for where woman graces an assemblage with her presence virtue presides; and our esoteric cavilers were easily silenced by the assurance that a semblance of secrecy was necessary to let farmers in and keep non-farmers out; but it was a mere semblance, for the secrecy did not extend beyond "a ceremony of initiation, which binds us in mutual fraternity as with a band of iron, but, although its influence is so powerful, its application is as gentle as that of the silken thread that binds a wreath of flowers."

With these cobwebs swept aside, it was amazing how rapidly the scales fell from the eyes of our inquisitors. From the Potomac to the Rio Grande, from the Golden Gate to the Hudson, and even on into the pineries of Maine, and across the border, throughout the length and breadth of the Dominion of Canada, farmers fairly leaped, as with one preconcerted bound, to the upholding of the Grange standard.

I have already confessed my inability to define the term "agricultural education"; with humility I make the further confession, as a representative farmer, that an agricultural education is not an accomplishment possessed by the average American farmer, and further that the shrewder, quicker, more crafty, and perhaps better educated classes of American citizens are neither professional nor practical farmers. And where farming and planting is the avocation of a majority of our citizens, I know it is almost impossible to say who is or even who is not "interested in agricultural pursuits," to use the language of the Grange constitution. Hence, with the public mind ready and waiting to seize upon some form of organization, as it was in 1873 and 1874, and with the hurly-burly rush of this majority class into an association admitting all who were "interested in agricultural pursuits," the wonder to my mind is that the Grange was not perverted from its legitimate purposes by the admission of those whose entrance to the fold, if not sought for sinister ends, was certainly not intended for the aggrandizement of the farmer or his vocation. Frequently had it to bear the odium of other men's sins, when denied the opportunity of correcting a misguided public opinion. For instance, there existed in Illinois and Wisconsin or other sections of the Northwest, at sundry times, agricultural clubs, composed of men who could not or would not join the Grange, whose province seemed to be to wage war against transportation companies. Anathemas thick and heavy were hurled upon the Grange for making this attack, whereas every Patron of Husbandry knew that the Grange, as such, was not a participant in the fight from beginning to end. To say that Patrons did not sympathize with and rejoice at the result of this contest would be admitting their complaint of grievances as ill-founded; but as an organization they could not have participated, for such a course would have been in violation of their organic law.

The keel of the Grange ship was well laid. Its majestic sides were ribbed by the mechanism of profound thought. Its spars, braced by fraternal cords, have never been shattered by the fury of the storm. Its sails are still whole, and have been whitened by the friction of popular criticism. Often has it buoyed in turbid waters. Still oftener has it glided gracefully and triumphantly over the billows of prejudice that lashed so furiously under its bow. To-day it floats in placid waters. Its haven has not yet been reached. nor will it be until every farmer in the land shall have received some of the benefits of its launching.

The harvest of improvement which the American farmers reaped during the prosperous era of the Grange, and which is still ripening in every State of this Union, can, not be limited to a monetary valuation. The social elevation, the moral improvement and the educational advancement have been beyond comprehension. These three grand purposes are never ignored nor forgotten from the moment the initiate closes behind him the outer door of the Grange hall until by death or from other causes he dissolves his connection with the order. Every precept of the order is elevating and improving. The steps taken by the applicant in his passage through the four degrees that must be conferred upon him before he is acknowledged to be a Patron of Husbandry in good standing all have this tendency. He who enters the fold must begin with the rudiments of his vocation, and be taught that "he who will not plow by

reason of the cold shall beg in the harvest, and have nothing." Beginning as the humble *Laborer*, who clears the forest, or digs the ditch, or prunes the vine, or turns the sod, he is instructed that all honest labor is honorable, and has the doctrine inculcated on him that he must "drive the very plowshare of thought through the heavy soil of ignorance, and thus prepare the mind for the growth of knowledge and wisdom." Advancing one degree he becomes a *Cultivator*, when his moral nature is educated and refined by repeated assurances that he who intelligently cultivates the growing plant is brought into close companionship with his Creator. "As we see the beautiful transformation of seeds into attractive plants, we have but another lesson of the wondrous works of God; and if the beauties of this world, when rightly viewed, offer so much of the magnificence of the Creator to charm us here, what must be the sublime grandeur of that providence above, not made with hands but eternal in the Heavens."

Nor do the lessons of encouragement cease when the *Harvester* is warned that he must reap for the mind as well as the body, because nature has made nothing in vain. "Wherever she has made a habitation she has filled it with inhabitants. On the leaves of plants animals feed, like cattle in our meadows, to whom the dew drop is an ocean without a shore; the flowers are their elysian fields, decorated with cascades, and flowing with ambrosial fluids." Hence, the *Harvester's* duty is to cultivate an observing mind, for it is delightful to acquire knowledge, and much more so to diffuse it.

But he who harvests must not rest content until he has by lawful means attained to ownership of the products of his own toil, and thus become an *Husbandman*, who, while he was passing practically through the hardships of a farmer's life and has had them emblematically riveted upon his moral nature, has learned to look with careful solicitude upon children and encouraged in them a love of rural life by making its labors cheerful, for what children see makes the most lasting impression upon them. "We may tell them of the pleasures and independence of the farmer's life; but if their daily intercourse with us shows it to be tedious, irksome, and laborious without any recreation of body or mind, they will soon lose all interest in it and seek employment elsewhere. We should therefore strive to make our homes more attractive. We should adorn our grounds with those natural attractions which God has so profusely spread around us, and especially should we adorn the family circle with the noble traits of a kind disposition, fill its atmosphere with affection, and thus induce children to love it."

But the attractions of a farmer's life are not within the keeping of the *Husbandman* alone. It is not his exclusive prerogative to fashion and shape the character of those plastic youths who in the future are to wield the destiny of our country. It is the mother's influence that molds the child into noble manhood or bewitching womanhood. Therefore the founders of the Grange, reverently approving the Divine injunction that "it is not good that the man should be alone," introduced woman into the Order; but in doing so they required her to enter as a *Maid*, whose station in the Order involves the common and lowly duties, preparatory to advancing to all that is most honorable and useful. As *Shepherdess* she is admonished that it is her sacred duty to reclaim the wandering, as well as to keep in safety those in the fold; and as *Gleaner* only to glean the good seed, remembering "that our associations in life are the fields in which we reap." And thus, when she reaches, through successive degrees, the responsible position of *Matron*, she is solicited "to wear garlands of noble deeds that shall adorn her life on earth and be crowns of rejoicing in immortality."

Thus it will be seen that the Grange is a family where the father's manhood, the mother's devotion, the brother's affection, and the sister's love are so cultivated and developed that they reach out beyond the purview of the family circle, and embrace with fraternal kindness every member of the Order, practically obeying the injunction of our Saviour when he said: "The second commandment is like unto it: Thou shalt love thy neighbor as thyself." This is the fellowship to be found in the Grange, and it is the fellowship of the noblest character. Twenty-nine days in the month social differences, moral convictions, or political prejudices may estrange Patrons of Husbandry, but when on that thirtieth day of the month they meet on a common level in the Grange, all these alienating features are dissipated.

Is it any wonder, then, that farmers are attracted to the Order? Nay, verily, the greater wonder is that every farmer in the Union is not an active colaborer with those of us who are desirous to so impress the advantages of the Grange upon the agricultural mind of the country that it, as an organization, may never be defaced by neglect, injured by prejudice, nor destroyed by ignorance, but may go on prospering and to prosper until it shall merit the fulfillment of its own selected motto—

"ESTO PERPETUA."

Hon. M. R. WISE, of Pennsylvania. Mr. President, if it is in order, I offer the following resolution.

The PRESIDENT. I wish gentlemen would be kind enough to announce their name and locality when they address the chair. The resolution

offered is that a committee of three be appointed by the chair to call upon Hon. D. W. Aiken, of South Carolina, for a copy of his address delivered before the National Agricultural Society, for the purpose of having it printed for circulation. What will you do with the resolution?

Mr. AIKEN. Will you please allow me to hear that read again? My attention was called away for a moment.

The resolution was again read by the chair.

Mr. AIKEN. I appreciate very highly, sir, the compliment paid me. As I understand it, the papers read before this convention go into the hands of the Commissioner, and I have no control of that paper. It is now in the hands of the Commissioner of Agriculture, and goes to the secretary, as I was advised would be the case. I presume it will be published in the proceedings of the Convention.

Mr. WISE. That is all I wished to know; but, having entertained a doubt, I thought I would offer the resolution.

A DELEGATE. Mr. President, I presume a wide circulation will be given this paper. I heard a portion of it, and I was so much charmed with the part I did hear, I am not only anxious for it to be published with the proceedings, but I desire to have it given a still wider circulation. I am satisfied that very much good would result therefrom. I think the purposes and objects of the Grange are misunderstood by a great many people. I believe the institution to be a good one if kept within proper bounds and the line that is marked out for it, and I should be pleased, for one, to have this address given a wider circulation in pamphlet form throughout the country. If it has been placed in the hands of the Commissioner of Agriculture, I trust it may be withdrawn temporarily, for the purpose of allowing the committee to procure a copy for publication.

Mr. AIKEN. I certainly could not object, sir. I am only gratified that the paper has been deemed worthy of the remarks made by the gentlemen, and I would be proud to have it printed, of course. I have no doubt that the Commissioner of Agriculture will print any number of copies that may be required.

Mr. BLAND. Mr. President, I have asked my honorable friend for a copy of that address to publish in a new agricultural paper, of which I am the editor, and to be issued in this city.

Mr. WISE. I was about to add that probably such a concise history of the Grange movement would warrant publication in pamphlet form, yet at the same time I do not wish to go outside of the Agricultural Department. I know that Commissioner Loring will probably do everything he can, and, in order that we may have it generally circulated, that he will not only include it in the report of the Convention, but allow it to be published in pamphlet form as well.

Commissioner LORING. I desire to say, Mr. President, that the proceedings and the papers presented here, will be classified by a committee appointed for that purpose, and papers to be printed as specials will be issued at once.

Mr. WISE. By the Department here?

Commissioner LORING. Why, there is nobody else to do it I called this Convention in order that the farmers, through the agency of the Agricultural Department, might have an amount of information that doubtless will be useful. Some of this information will be given in specials, and other papers that are of a scientific nature will be printed in the annual report as a part of that report. I have been very desirous of improving, if possible, the character of the reports. I have in-

structed heads of divisions—heads of scientific divisions—to prepare their scientific papers in such form that I can present them in specials, and that, for the benefit of the farmers, an intelligent *résumé* shall be provided for the annual report, so that, when the report is out, the community in general will find an amount of information in it that they can understand, while at the same time those interested scientifically in the colleges and elsewhere, will likewise, find tables and other scientific documents in useful form. This is the object of the Convention, and that object will be carried into effect. There will be no paper read here by any member of this Convention that the Department will fail to print, unless the committee which you have appointed for that purpose instruct the Commissioner not to do so.

Mr. WISE. Otherwise it will be printed.

Commissioner LORING. Why, you have been in Congress long enough to know that the Department prints everything.

Mr. WISE. But this is an independent meeting.

Commissioner LORING. This is not an independent meeting at all. This is a part of the Convention.

Mr. WISE. Mr. President, I would like to ask the Commissioner now whether this will be published independent of the annual report, or whether it will not be published until the annual report of next year.

Commissioner LORING. I do not think that either Colonel Aiken or myself desire to have it moulder in the archives before it reaches the popular ear.

The PRESIDENT *pro tempore*. I think it eminently proper that the Convention should act on the resolution as a guide to the Commissioner. Will the secretary read the resolution again?

The secretary read the resolution.

Commissioner LORING. I can only say there is no occasion for any such resolution at all in regard to this paper or any other paper. They will all be published by the Department.

Mr. WISE. That is enough.

A DELEGATE. Mr. President, there seems to be a disposition to give this paper a wider circulation than would be likely to come from the Department. Is there any objection to any man, or set of men, printing that paper independently?

Commissioner LORING. No, not the slightest. I will say, however, that I do not wish the great mass of the papers read here to get into the newspapers before the Department can publish them, because that takes the work of the Department out of the hands of the Commissioner. But, of course, when a paper is printed in special form and issued, the whole newspaper press and the pamphlet press have a right to it.

Mr. WISE. A word, Mr. President. We have more conveniences here than we should have had at the Ebbitt House, and I did not know but that the Commissioner of Agriculture was just kind to us—let us come in here and go into session, accommodated us with his building, and all that. But I was not aware that it all came under the supervision of the Agricultural Department, and therefore I wish to withdraw the resolution.

Commissioner LORING. The paper which Mr. Aiken has read was included in the list announced by the Chair yesterday morning, and the time fixed for its delivery was before the Convention to-day. The paper stands, certainly, with the rest of the papers, and none of them require any increased force to induce the Commissioner to publish them. It is my desire to publish them. A committee was appointed—which was

somewhat novel—to formulate the business of the Convention and supervise the papers that were presented, but I do not imagine that committee will rule out any paper read here. Why, this Convention was called by myself, and met here to deliberate upon the agricultural interests of the country. It was called for that special purpose. I did not consider it a favor. The kindness, however, is on the part of those who attend it, because I might call until I was hoarse, and if nobody answered it would not amount to anything. I only hope to secure out of this Convention, as a sort of nucleus, a mass of interesting and useful information for the farmers.

Mr. WISE. Then, Mr. President, as an apology for my action, let me explain the facts. When I first entered the hall an organization adjourned, and then this organization began. I thought this organization was entirely independent, and thereby I offer this explanation to the Commissioner.

Commissioner LORING. No apology is necessary. The old United States Agricultural Society—for which I have the most profound respect, which really inaugurated the whole business of agricultural investigation in this country, and ought to be revived—have a charter from Congress as a great national organization, and every gentleman in this room should encourage and stand by that society, not only for the benefit of the Department, but for the benefit of all local organizations that can co-operate with it. This society asked me for an hour in this hall this morning in order that the president might read, and gentlemen assembled under my call might hear, a statement with regard to its history. I was very glad, indeed, to give an hour, and would have yielded more if it had been wanted. Now, the matter which confused Mr. Wise was that we did not adjourn. They had their hour; the president's statement was an interesting one. We passed a vote with regard to the association—those few of us who belong to the society—and adjourned. Then the Convention of the Department resumed its labors.

Mr. BLAND. Respecting the distribution of this paper, I am quite contented to leave it with the Commissioner to do as he has said. I only desire that a wide circulation shall be given this pamphlet by itself, so that it may be generally read. I do not know what the form of printing and publication or the distribution intended might be, but I am quite content to leave it with the Commissioner.

The PRESIDENT. Shall I announce the next paper, or is there any discussion to be had upon the one Colonel Aiken has read? [After a pause.] If there is no desire for that, I will announce that the next paper to be read is by Mr. Clifford Richardson, upon "What Science can Teach about Wheat."

Mr. Richardson thereupon read the following paper:

WHAT SCIENCE CAN TEACH ABOUT WHEAT.

By CLIFFORD RICHARDSON.

In the report of the Department of Agriculture for 1881-'82, I have shown how largely the composition of grasses is influenced by the nature of the soil upon which they are grown; the contrast between timothy from the highly cultivated soil of the grounds of the Department and that from an average New Hampshire farm being very marked. At the same time, a comparison between our wild and cultivated grasses was made, and these again with grasses grown upon German soil which has been under the farmer's hand so much longer than any soil in our country. The conclusion in all cases was that the more highly cultivated the soil, the richer the plant in valuable nitrogenous constituents. The data may be found upon pages 551-552 of the report above mentioned. From these results and the interesting paper of Professor Blount, of Colorado, which he read upon cereals at the Convention of last year, I

was led to examine from a chemical point of view the changes in the composition of wheat produced by environment.

Professor Blount left in my hands thirty-two samples of wheat which he had raised in Colorado during the season of 1881, and whose quality he had improved largely, at least so far as appearance was concerned, by selection and crossing. Analyses of these wheats were made and have been published. In addition, a large number of wheats from other parts of the country were examined, and all previous analyses of American wheats were collected for comparison. From these data I have been able to derive the following conclusions:

In comparison with wheats grown upon highly cultivated soils of the continent of Europe, American wheats, like American grasses, appear to be deficient in nitrogenous constituents. The causes of this difference may be three in number—the effects of climate, soil, and selection of seed.

The effect of careful selection of the seed must be evident to all, and was shown by Professor Blount last year. The effect of soil is plainly shown in our analyses, while the effect of climatic changes is very small, wheats from Georgia and from Canada possessing approximately the same composition.

The changes produced by soil are well illustrated by twelve wheats grown in Colorado during the past season. The seed was furnished by the Department of Agriculture, and was analyzed under my direction. The crop was to the eye a marked improvement over the seed, the weight of one hundred kernels having increased from 3.4 grams to 4.3 grams. The question arose whether this universal improvement in size was followed by corresponding improvement in composition.

The average content of nitrogen in the seed wheats was 2.07 per cent, and that of the crop 2.09 per cent., so that at first no change was apparent; but on further examination it was seen that of the seed wheats six fell below the figure 2.07, having an average nitrogen content of 1.86 per cent., while five contained a larger amount, an average of 2.33 per cent., and one about the average 2.02. In the crop it appeared that the six wheats mentioned as falling below the average in the seed, had improved till they had reached the average 2.07. The five wheats above the average had fallen nearly to it; that is, to 2.13 per cent., and one wheat which contained the average amount had not changed. This seems to show, then, that the Colorado soil has a capability for growing wheats containing about 2 per cent. of nitrogen, and if a seed is planted containing more, it will be reproduced with only this 2 per cent., while if it contains less it will increase toward that figure, wheat containing about the average being reproduced without change.

To improve the wheat, then, upon this soil, the source of nitrogen must be increased, for during two years' growth of wheat upon it, with careful selection of the seed, the average composition of the grain has not changed, or only slightly. This soil, though a comparatively new one, seems to be particularly suitable to the culture of wheat, or it has been rendered so by Professor Blount; for it is the only soil in the country which produces a wheat, *which I have seen*, having a composition equaling that of continental growers, and this is unusual, because, as a rule, a new soil furnishes a plant deficient in nitrogen. For example, the average amount of nitrogen in an Oregon wheat (derived from seven analyses) is 1.46 per cent., while that of ten wheats grown along the Atlantic coast is 1.77 per cent.

How little the composition of a wheat depends upon its size, or rather corresponds to it, may be seen from the average weights of the following:

Name of wheat.	Years.	Weight.	Nitrogen.
			Per cent.
Egypt	(?)	5.5	1.47
Colorado	1881	4.8	2.14 (32)
Colorado	1882	4.3	2.09 (12)
Department seed	1882	3.4	2.07 (12)
Oregon	1882	4.8	1.33 (2)
Virginia	1882	1.8	2.24 (1)

A comparison of the Colorado wheats of 1881, the Oregon wheats of 1882, having the same weight, and the Virginia wheat, shows that very large and fine-looking wheats may vary very much in composition, while an extremely small wheat may equal a very large one in its content of nitrogen. The Colorado wheat must, however, be regarded as the normal one, that grown in Oregon and also that in Egypt having developed an excess of starch, thus lowering the relative amount of nitrogen, the Virginia wheat, from its stunted development, containing a large relative amount. Both would have poorer milling properties than the Colorado sample.

A soil may have, then, capacity for producing a large grain without a large percentage of nitrogenous substance, and consequently of poor milling properties, and new soils seem to have the greatest tendency in this direction. The wheats of Austra

lia seem to show this peculiarity as well as American, for it will be seen in the table accompanying this paper that they are even lower in nitrogen than ours.

Our conclusions, then, must be that the more highly cultivated a soil, the higher the percentage of nitrogen in the wheat, and consequently the better the milling properties, and that the farms which have been carefully cultivated for many years east of the Mississippi produce a better wheat than the new farms of the West; that there is an opportunity to improve the wheat of America, as has been shown by Professor Blount, of Colorado, and that the opportunity lies more in the soil than in the seed.

These conclusions, derived from analysis of the grain, are confirmed by Professor Atwater's field experiments with fertilizers. He finds that wheats respond to nitrogenous manures in a way much more marked than many other crops, such as corn, which are able, owing perhaps to their longer period of growth, to obtain their nitrogen from the ordinary supplies of the soil. An examination of the composition of the maize kernal from various parts of the world, shows that under all circumstances the amount of nitrogen is subject to much less variation than wheat; that is to say, it is less dependent on the soil than wheat. From the point of view of the analyst, then, we should conclude that nitrogenous manures would be profitable for wheat and grass crops, but not remunerative with corn. How true this may be will be shown by experiments in the field.

The accompanying tables show the data which I have collected and upon which I have based this paper.

Comparison of Department seed and Colorado crop.

No.	Total nitrogen.		Weight of 100 kernels.		
	Department.	Colorado.	Department.	Colorado.	Colorado.
785	2.18	.....	2.811	.....	Increase in nitrogen, 6.
786	.....	2.24	.....	4.159	Decrease, 5.
787	1.38	.....	3.285	.....	No change, 1.
788	.....	2.02	.....	4.125	Average increase, 1.86 to 2.07.
789	1.76	.....	3.278	.....	Decrease, 2.33 to 2.13.
790	.....	1.90	.....	4.347	No change, 2.02 2.02.
791	2.02	.....	4.023	.....	Average, 1881, 2.14.
792	.....	2.32	.....	4.610	
793	2.24	.....	3.218	.....	
794	.....	2.18	.....	3.976	
795	2.49	.....	3.417	.....	
796	.....	1.99	.....	4.335	
797	1.57	.....	3.076	.....	
798	.....	1.96	.....	4.374	
799	1.76	.....	2.930	.....	
800	.....	1.99	.....	4.027	
801	2.32	.....	3.586	.....	
802	.....	2.27	.....	4.103	
803	1.93	.....	3.741	.....	
804	.....	1.85	.....	4.450	
805	2.66	.....	3.660	.....	
806	.....	2.38	.....	4.423	
807	2.02	.....	3.756	.....	
808	.....	2.02	.....	4.609	
	2.07	2.09	3.402	4.299	

Percentage of Albuminoids in Wheat.

Mediterranean.	English.	Missouri.	Canada.	Oregon.	Maryland.	Ohio.	Pennsylvania.	Georgia.	Virginia.	New York.	Dakota.	Tennessee.	Michigan.	British Columbia.	Oregon spring.
11.55	9.63	11.59	9.45	8.40	12.43	11.59	11.20	10.15	12.78	10.85	10.68	11.90	11.64	12.25	8.40
10.85	10.50	11.55	9.89	9.47	9.98	.....	.....	9.45	10.15	.....	.....	11.43	12.38	11.88	.....
.....	.....	11.79	.....	8.58	12.25	.....	.....	.....	11.55	.....	.....	.....	13.78	13.45	.....
.....	.....	.....	.....	8.58	.....	.....	.....	.....	.....	.....	.....	.....	11.81	.....	.....
.....	.....	.....	.....	8.05	.....	.....	.....	.....	.....	.....	.....	.....	11.88	.....	.....
.....	.....	.....	.....	10.63	.....	.....	.....	.....	.....	.....	.....	.....	11.81	.....	.....
.....	.....	.....	.....	10.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	.....	.....	9.17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

Wheats of the world.

Description.	No. of analysis.	Per cent. of nitrogen.	Per cent. of albumen.	Highest albumen.	Lowest albumen.	Weight of 100 kern.	Authority.
Russian	5	2.34	14.63	16.56	14.24	3.610	Von Bibra.
North German	25	2.24	14.00	18.26	9.80	4.498	
South German	13	2.17	13.56	17.76	10.21	4.465	
Germany	.....	2.11	13.19	.....	.....	.....	Kühn.
Germany	.....	2.08	13.00	.....	.....	.....	Wolff.
Spanish	8	2.10	13.13	15.29	11.20	4.270	Von Bibra.
French	.....	2.08	13.00	.....	.....	.....	Roiset.
Scotch	14	2.01	12.55	.....	.....	4.680	Von Bibra.
Australian	2	1.60	10.00	9.98	9.92	.....	Do.
Egyptian	5	1.47	9.19	9.92	8.75	5.540	Do.
American, excluding Blount's	82	1.89	11.82	16.63	8.05	.....	
Blount 1881, Colorado	32	2.14	13.40	15.94	11.19	4.833	Various.
Blount 1882, Colorado	12	2.09	13.06	14.88	11.55	4.299	Richardson.
Michigan	34	1.93	12.13	14.47	10.94	4.116	Do.
Missouri	7	1.82	11.35	12.44	10.50	3.553	Do.
Atlantic States	10	1.74	11.08	12.78	9.45	3.467	Do.
Oregon	7	1.46	9.17	10.63	8.05	4.800	Do.

Mr. RICHARDSON. I know of a large farm of some 500 acres on the eastern shore of Maryland, where the only fertilizer used for many years has been superphosphates. They are able to raise a large crop of wheat upon the soil, but the wheat, when it is raised, is very poor in nitrogen, and the reason is that the soil has not been worked up in that portion sufficiently to produce rich wheat.

A DELEGATE. I wish to ask the gentleman a question; and to get at my point I will say that your assertion seems to cover the entire United States.

Mr. RICHARDSON. Yes, sir.

The DELEGATE. Have you analyzed the wheats of Northern Minnesota and the Red River Valley?

Mr. RICHARDSON. I have had no opportunity of getting samples of either Northern Minnesota or Northern Dakota wheat.

The DELEGATE. An expert on wheat sent out by the Hungarian Government to determine the question whether the wheat grown in the United States could compete with the highly nitrogenous wheat of Hungary, said there were no wheat lands that could produce this highly nitrogenous wheat except those of Northern Dakota and the Red River Valley.

Mr. RICHARDSON. I have not had an opportunity to examine the wheat of those sections. This has been an investigation I have undertaken very recently. I have analyzed all the seed that has been sent out by the Department this year, and my plan is to obtain samples of wheat raised all over the Union, together with specimens of the soil, and from this data to get more accurately at the composition of the wheat.

The DELEGATE. If this statement be correct, it would seem to controvert the proposition that virgin soil could not produce as highly nitrogenous wheat as the old country, and to establish the fact that there might be peculiar conditions under which the virgin soil might compete with the more highly cultivated and nourishing soils of the Old World.

Mr. RICHARDSON. I have analyzed about 150 wheats, and I thought

from the data obtained, the conclusions were fairly warranted. They are not by any means absolutely conclusive, since the continued work of five or six seasons would be necessary. But the matter seems to be of such interesting nature as to be worthy of bringing it before the Convention that I might be assisted as much as possible.

The DELEGATE. Have you found any important differences in the various varieties of wheat grown on different soils in different years?

Mr. RICHARDSON. Very slight differences in that way. In fact, in thirty-two wheats last year the difference was very inconsiderable; yet the average for the whole year 1881 to 1882 only varied six one-hundredths of one per cent.

Mr. FOREMAN. I would like to ask the gentleman a question. I am a miller, living in the Indian Territory. I get wheat from various portions of the Territory, but our millers merely require to know where the wheat came from. Tell us the district, and we need hardly look at the wheat. We make up our minds directly what the result will be in the flour. We find that if the wheat is produced upon the new limestone soil, it is of extra quality, and without going to the wagons to look, we will pay his price. Ours is a new country, and this land is bearing its first crop. There is another section of the county—the black land. It is our strongest land. The land being strong, the grain grows ranker, and yet the price is lower. Now, it depends upon the locality. It is not a national question. It is a question upon what land it is produced, and if the land be limestone land, either in Canada or the United States, you will inevitably have good wheat. Come into the land of the Arkansas, the land 15 feet deep of soil, the finest in the world. It will grow as high as the head of a man, yet at the same time it has not the flouring quality of the wheat grown upon limestone land.

Mr. RICHARDSON. That is the very point I have been trying to bring out. I am very glad to have my theories confirmed by practical men. My results seem to prove that a fertile soil does not necessarily produce valuable wheat, and that the more highly cultivated soil will not always give the best results.

A DELEGATE. We would infer, then, that lime would be a very valuable dressing.

Mr. BAKER, of Ohio. I had a talk with Professor Blount, of Colorado, on this subject. I had it from him a year ago last fall, that his best wheats were not raised upon the virgin soil.

Mr. FOREMAN. I was raised in Canada, a thorough wheat farmer. The lands we cleared off there in the early days, when we struck the strong blackish swamp lands, could not for years produce wheat at all. A Canada farmer will not attempt such a thing. His first crop is oats, and when he gets his land thoroughly reduced to a condition fit for wheat, he will raise wheat. A Canada farmer, if you send to him for his opinion, will confirm what I say, that Canada farmers will not attempt to produce wheat on the black soil. It is too strong, and runs to straw. I do not accept this from theory; I accept it from solid, practical experiment, and know it to be the case. The wheat in our country that is brought from the Canadian Valley, a black and strong land, grows too rank. Years hence they may produce good wheat. Therefore Professor Blount is thoroughly right. If it be improved limestone soil, I should be willing to give it a test.

Mr. RICHARDSON. I should be very glad if any gentleman will furnish me with samples of the soil.

Mr. FOREMAN. I will take pleasure in doing so the moment I arrive at home.

The PRESIDENT. The question of the cultivation of wheat is still open, gentlemen. Has anyone made any suggestion relative to fertilization of wheat with respect to the straw of wheat? That is the practical difficulty with us East, and no nitrogen manures will relieve us. We cannot grow wheat well in Eastern Massachusetts, in an ordinary season, on account of the difficulty in making the straw stand up. A wheat crop that has no straw to hold it, is rather a poor thing for the farmer to have. The statements made by Professor Richardson are intensely interesting as well as extremely valuable, and they ought to arrest the attention of every scientist in this assembly. It is well known that the wheat crop is one of the most capricious we have. The corn crop will stand any amount of difficulty and accommodate itself to every variety of circumstances; hence it is really the universal crop. A crop of 1,670,000,000 bushels annually means something enormous, and is a vast mine of wealth. When the corn crop of a country is cut down, as it was year before last, from 1,800,000,000 to 1,100,000,000, the country feels it from one end to the other. Now, as compared with that, the wheat crop has reached a little more than 530,000,000 or 540,000,000 bushels, and this, too, is an enormous crop to meet the demands of domestic consumption and export. In order that the wheat crop may be properly handled, we should, I am satisfied, know more about the proper fertilization of wheat. We should know how to give silica to the straw and nitrogen to the grain. What Professor Richardson has stated with regard to the comparative value of wheat, is a matter which has been most carefully discussed here and in Europe, and I have a paper now in my possession, sent me by Mr. Moffet, of London (whom I have appointed a special agent of the Department in connection with the consular agency, to report to me monthly or weekly, if necessary, the state of the markets and crops of Europe), which is an admirable essay upon this comparative value of wheat and the importance of keeping it in proper condition. I have no doubt it meets the very point which Professor Richardson has presented. But in face of all this, and of the fact that better wheat is grown on old soil in Europe than on new soil in America, so far as the nitrogenous matter is concerned, it is true that the old land in the eastern section of this country does not produce wheat that will stand up and bear its grain. That is a matter which should not be forgotten. The experiment of wheat-growing on the Maryland farm, where there was not enough nitrogen to impregnate the wheat perceptibly, is a very interesting and very extraordinary fact.

I think the question which should be investigated by experiment stations and colleges is how to increase the nitrogenous properties of the wheat, in order that the crop will be good and the straw strong.

Mr. RICHARDSON. Let me say that Professor Blount dwelt largely on that point.

The PRESIDENT. Yes; I remember that.

Mr RICHARDSON. He said, in cases of wheats that did not produce sufficient straw to hold the heads, the proper way was to hybridize and improve the wheat in that direction. The wheats he handed me last year were many of them cross-bred for that purpose, wheats that would not stand well with those having a good straw, and so on. It seems to me the thing to be looked after in the East is proper selection in crossing the seed.

Mr. COFFIN, of Iowa. It may be interesting to those Eastern gentlemen, and especially the scientists present, to state the facts in regard to our wheat in Northern Iowa. When we turn over the prairie there our first crop has been wheat, and we never have any trouble in raising

good wheat—remarkably good wheat. Now, after we cultivate those lands and raise crops of corn on the same ground, the next crop of wheat there is a grand one. It heads well and looks well, but perhaps three times out of four it will blast in the head. It does not fill out; there is something the matter. The straw is good enough, but we get little wheat and poor quality. I only get four, five, and six bushels to the acre sometimes.

The PRESIDENT. Has any one ever accounted for that, Mr. Coffin?

Mr. COFFIN. We farmers say that it blights by the hot sun just before it is ripened—the singeing by the sun. Perhaps Professor Knapp, of the Agricultural College, can furnish a reason for it.

Professor KNAPP. Do all varieties of wheat suffer in the same way?

Mr. COFFIN. Yes, sir. Sometimes we get a variety that for a year or so will do well, but in two or three years it turns out the same.

Professor KNAPP. Has any one tried different modes of fertilizing to see what effect that would have?

Mr. COFFIN. We don't fertilize much. If we manure our lands heavily, as for oats or corn, it falls down; the straw is too weak.

Professor KNAPP. Stating more fully the conditions of the virgin soil turned over in precisely the manner referred to, we formerly attained excellent crops of wheat, whereas now it is just as bad a failure as on old land. I have, in the last three years, tried 64 varieties of wheat from all parts of the world, and have found only two that seem to stand our conditions. The hard wheats do much better than the soft wheats, and I see but one way to account for the changed conditions. In the first part of July, about the time the wheat passes into the dough state, the intensity of the sun is such that it blights the wheat. Why is it that the sun is more intense now than formerly? Formerly, the black soil of that country was mainly covered at that period of the year with grass—grass nearly 18 inches high, and that retained to a large extent the earlier rains. We know that the sluices which could not be crossed with horses and men, are now perfectly dry and good land to be tilled. Now the evaporation over this great extent of country was a cooling process near the surface of the earth, and when all that came to be turned over, as all but about 5 per cent. of the land is arable, the whole country became a black surface, and the conditions were intensified to the destruction of the plant. If we could cool the surface 8 or 10 degrees by evaporation, we could control these conditions, and I trust that, when our lands are more seeded to the grasses, and we have more meadow lands than at the present day, the original conditions will be restored to some extent.

A DELEGATE. A year ago I was in Wisconsin, and I was told there that the virgin prairie turned up now would not produce as well as when the country was first settled. I asked the cause, and was told it was ascribed to lack of potash. It is a fact that in Southern Indiana, on limestone ledges, they never have any trouble whatever with the straw. There is a great deal of silicacious matter in wheat, and that gives it its stiffness. I think that whenever the wheat is not stiff enough, it will be found to be benefited by the application of caustic lime and of potash.

Mr. FOREMAN, of the Indian Territory, then described his method of preparing seed-wheat for planting.

The PRESIDENT. I wish to announce a committee, which is requested to meet at the room of Mr. Sanders, of Chicago, at the Riggs House, at half past seven o'clock this evening, to consider the propriety of Congressional action respecting pleuro-pneumonia, and with regard to a

veterinary division for this Department. It is a question of great importance with the cattle-growing sections of the country.

The committee will consist of Messrs. Sanders, of Illinois; Coffin, of Iowa; Curtis, of New York; Gold, of Connecticut; Grinnell, of Iowa; Grinnell, of Massachusetts; Dodge, of Maryland; Dudley, of New Jersey, and Beverly, of Virginia.

These gentlemen will meet at the Riggs House at half past seven.

Mr. COFFIN, of Iowa. I move we now adjourn until 2 o'clock this afternoon.

The motion was agreed to.

AFTERNOON SESSION—SECOND DAY.

The PRESIDENT. The Convention will come to order. Here is a chart sent me by the statistician of the Department, showing the yield of wheat per acre in bushels in the various groups of States in the country. The United States average reaches 13. There are certain very curious facts here. The Ohio Basin and the Lake States, not including the new section of the country, reach an average of 16 bushels. Next to that come the Pacific States, which are well known to be equally good wheat-growing States. The yield of the Pacific States is 16 bushels. New England, older still, under the modes of cultivation there, reaches 15½ bushels. The Territories, including Dakota and other wheat-growing sections, have reached 15 bushels. The Northern Middle States, 13½, and Southern Middle States, 10 and 9½ bushels. The Trans-Mississippi States, 10½; South and Southeastern States, 5, and the South Atlantic States, 5¾. These are certainly very curious and significant facts. They show that cultivation will produce wheat, if that cultivation is of the proper description, even on old lands; and I would suggest to the Convention that, after all, it must be to a very considerable extent owing to the kind of fertilizers employed.

The suggestion made by Professor Wiley in regard to silicates necessary in the soil, and the propriety of using certain solvents to make them valuable, is worthy of consideration. That is needed in the older soils for the straw, as much as nutrition is needed for the grain. Now, put the two together and see if you can invent some way of providing nutrition for the grain and silicate for the straw. Then you can get a wheat crop, and a wheat crop can be cultivated just as much as an onion crop.

With regard to such misfortunes as have befallen the State of Iowa, which are beyond the reach of man to account for, there is a little map showing what Iowa yields by counties. It runs down as low as between 9 or 10 bushels for certain counties, and never gets above 13.

Professor WILEY. I would like to state, Mr. President, in connection with this, that I know one county in Indiana where the yield of wheat has been increased in the last ten years from an average of 5 bushels an acre to 20 by the use of simple fertilizers. The average is now 20 bushels an acre. These fertilizers are chiefly superphosphates, and it is perfectly marvelous to note the effect they have had upon the yield of wheat in that county. It is an old county, too; one of the first created in the State.

A DELEGATE. Professor Wiley, a gentleman from Iowa wishes to inquire whether the phosphates are drilled in or put on the surface.

Professor WILEY. Almost altogether drilled in. That is almost universally the practice. At first they were thrown broadcast, but that is very rarely done now. I may say, in the northern part of the State,

however, they are not using these artificial fertilizers at all as is the case in Tippecanoe County, where I am now situated. They often get 30 to 35 bushels without any artificial fertilizer, but in Southern Indiana the use is almost universal. It does not pay in proportion to cultivate without it.

Mr. AIKEN, of South Carolina. Do you ever use these fertilizers in the spring?

Professor WILEY. Never as yet in Indiana, unless for experiments. They do plant a crop in the spring, but not a wheat crop. All wheat is planted in the fall. They always apply the fertilizer at that time.

Mr. AIKEN. Mr. President, the county in which I live is to a very large extent self-supporting, growing its own grain and its own meat, besides shipping about 25,000 bales of cotton annually. We are growing some of the grains more largely every year, chiefly oats and wheat, and experience has taught us that the commercial fertilizers pay infinitely better when applied in the spring. We sow our grain in the fall. Oats are sown in September and October; wheat generally in October and November. Probably in the latter part of January and the first days of February the entire crop will be harrowed just after being treated with the fertilizer; then a two-horse harrow is drawn over the crop. This is, we think, a better plan for two reasons. There is not so long a time before harvesting, but a more immediate application of the stimulating food to the growing plant, and it is a quicker return for our money. I have experimented a great deal with the Charleston fertilizers, and I have found a difference of as much as 5 bushels of wheat by the application of $2 worth of fertilizer per acre in the spring. I have found acre beside acre manured with 50 pounds of fertilizers, and the adjoining acre not manured at all with fertilizers, and one would yield double the quantity of the other. Usually the crop is about 50 bushels to the acre. Last year, which was a very remarkable season, many of us averaged 40 bushels an acre, and sometimes 50. I throw out this suggestion as a mere matter of information so far as experiment is concerned in my immediate vicinity.

The PRESIDENT. The papers to be read this afternoon are "Agricultural Education in North Carolina," by Professor Holmes, and a paper upon "Lawes' Views of Fertility," by Professor Scott. Now, gentlemen, General Curtis, of New York, has a little explanation to make in regard to the cutting of the potato for planting, as the result of certain experiments made, and which I think he had better lay before you now, prior to the reading of the papers.

General CURTIS. It is a very short subject, and yet, if the experiments which have been made and the results obtained at the New York experimental farm shall be sustained, it will be of great value to the potato-growing interests. I have cut a potato here—a narrow slice from the center—in which, by holding it up to the light, you can see an appearance, found in every potato, of a central column with branches thrown out like the buds on the branch of a tree. Entertaining the opinion that the seed of the potato would be stronger and better for having attached to it a portion of that central column, it is thought best (and in the experiments thus far made—and there have been a dozen or more—all of which tend to confirm the theory) to cut the potato into as many pieces as it has eyes, commencing at the stem end and cutting each piece across this central column, as I have cut this potato, taking it in your hand, your thumb at the point, and taking the first eye and cutting it across the potato in this manner, so that it will take a portion of the central stem.

Now, where the experiment is made in planting an eye cut in that manner [exhibiting another specimen] shallow—just cut it out—why you will get a stalk, but you will obtain a very small yield. The experiments which were matured embrace the cutting in this careful manner which I indicated, and also of those cut in this narrow way, this shallow way, and of potatoes cut at random and cut once through. Cut in the manner I have described, the yield has been best as to quantity, and of marketable potatoes cut as I have just indicated putting a single eye, and cut across this central column of the potato. The difference was so great as to make it more than equivalent to the cost in the profits of the crop. Now, if that shall be verified, so that you well know that four bushels of potatoes of those kinds having numerous eyes will plant an acre with seed better calculated to produce a large proportionate crop of merchantable potatoes than the custom of planting whole ones of sixteen bushels, you set off with reserve enough to pay the interest on your land.

This is a very easy matter, and it may be worth your while to try it. It is a matter of experiment to make these tests. It costs nothing but the cutting of your potatoes and placing them out on your farm. If you care to use an illustration of it in a diagram (and I am not advertising anybody's seed house), Mr. Hiram Sibley, of Rochester, has taken up the sum of these experiments and published a diagram of the potato with the manner of cutting which I have indicated.

Professor Scott was then introduced and addressed the Convention as follows:

Professor SCOTT. Mr. President and gentlemen of the Convention, the paper which I have the honor to present is one concerning "Mr. Lawes' Views of Fertility," and I will state that my object is to elicit discussion and the opinion of gentlemen present concerning the important points which I propose bringing out in this paper.

CONCERNING MR. LAWES' VIEWS OF FERTILITY.

By MARTIN P. SCOTT, M. D., *of Virginia.*

He who contemplates nature should use much caution to preserve his understanding equable and unprejudiced.

CONCERNING MR. LAWES' VIEWS. WHAT IS FERTILITY?

Those who regard Mr. Lawes as an idol, or as an authority from which there is no appeal, will doubtless regard it great presumption in me to demur to some of the conclusions of the Rothamsted scientist. But it is permitted to mortals to gaze upon the stars of the firmament, and even to seek to interpret some of the laws which the Creator has put in operation to conduct the scheme of the universe. The Saxon geologist, Werner, 1775, promulgated a system of geology by exploring his own province and would persuade us that the whole surface of our planet, and all the mountain chains of the world were made after the model of his own little province. He had his universal formations, his common menstruum, his chaotic fluid. "The charms of his manners and his eloquence kindled enthusiasm in the minds of his pupils. in a few years a small school of mines was raised to the rank of a great university. Men already distinguished in science studied the German language and came from the most distant countries to hear the oracle of geology." In like manner, Lawes' would promulgate from his farm, Rothamsted, rules for the cultivation of all parts of the earth, and doubtless in due time will arise an agricultural university to which men of science will flock, and study the English language, that they may hear and understand the oracle of agriculture. The four winds blow in from every coast renowned scientists, which makes his seat at Rothamsted, "Colchos" strand, and many savans come in search of him.

It appears that there are two rival schools of agriculture, one at Rothamsted near London, the other at Vincennes near Paris. The rivalry is narrowed down to the question of the source of nitrogen for the plant kingdom. Do plants, or any class of

plants, draw nitrogen from the atmosphere, *i. e.*, feed upon the free nitrogen of the air, or are they dependent solely upon the supply of nitrogen laid up in the earth during past ages?

M. Georges Ville tells us that crops yield more nitrogen than is supplied in the manure; and that this excess is derived *not* from the soil but from the atmosphere. He points out how small is the amount of combined nitrogen existing in the air as ammonia and nitric acid: that crops cannot get more than 5½ pounds of combined nitrogen per acre annually, by rain; and that hence the source must be free nitrogen of the air. He concludes that leguminous plants, such as pease, clover and lucerne, take practically the whole of their nitrogen from the air, while there are some others which require a certain amount to be supplied by manure in order to establish active growth, but that after this they draw their supplies from the atmosphere; and lastly that others, such as the cereals, require the chief of their supply to be provided within the soil. Such views form the basis to guide the cultivation of the soil and the supply of nitrogenous manures for our different crops.

Lawes' views are quite inconsistent with those of M. Ville, more especially as regards the sources of nitrogen for the leguminous and root crop. For Lawes, fertility consists in the supply of nitrogen in the soil laid up during the thousands of years which preceded cultivation—that plants do not derive nitrogen from the atmosphere, but depend entirely upon the soil supply for this necessary ingredient. For Lawes, cultivation has for its object to extract this store, just as mining has for its object to extract the coal from the deposit. When the miner can no longer work with a profit, he abandons the vein; when the farmer can no longer extract nitrogen to pay him for his work, the land must be abandoned to lie out a sufficient length of time to accumulate a store of nitrogen.

All our operations, plowing, draining, mineralizing, and irrigation, contribute but to one end, to extract the precious nitrogen now existing in the "humus" of the soil. To say the least, the outlook is not encouraging, and a wise policy would dictate an immediate cessation of immigration, so that our stores of nitrogen may be kept for our posterity and not handed over to the pauper population of Europe, for every immigrant, instead of by his industry adding to our wealth, becomes a digger and consumer of our precious nitrogen. It appears that at last, man is only a parasite of the soil who, when he has sucked the nutrition from the earth, will perish, and herein lies the explanation of the destruction of the great empires in the past, and of the prehistoric races of men.

It is but a lame and impotent conclusion, that our boasted science can only tell us that our fate will be but a repetition of what has befallen our race in bygone ages. Indeed, the prospect becomes more gloomy when we consider that only the alluvial soils and the deltas have so splendid a store of nitrogen as analysis shows to exist in the soil of Rothamsted. We measure our soils by inches, not by feet; a few inches beneath the surface we meet with the infertile clay, or below the hard-pan, the porous sand, so that a few years of continuous cultivation will suffice to eat up our stores of nitrogen, to extract fertility. It is vain to exhort us to return nitrogen, to preserve manures, not to waste the precious nitrogen, for it will only prolong the agony. You can't grow rich by swapping jackets.

"Water, water, everywhere, but not a drop to drink!"

Nitrogen, nitrogen in the air around us, in the seas and oceans, lakes and ponds, in streams and rivers, and deep interred in the earth, yet not an atom for plant structure.

Between 1875 and 1880, there have been 31,000,000 acres of land added to the area of cultivation of wheat and corn in this country. Truly, agriculture progresses by "leaps and bounds," in the West, which threatens ruin to the East, for with cheap transportation, a discriminating railroad tariff against us, wheat can be laid at our doors cheaper than we can gather it from the neighboring fields. When we complain, the same answer is given as that by the Manchester manufacturer to the English farmer: "If you can't make a living by farming, go at something else."

"The stock of nitrogen in immense areas of the United States soils," says Mr. Lawes, "must be competent to yield crops (12 bushels wheat, 26 bushels corn) for a long time. The necessity of employing so costly a substance as nitrogen may not be apparent for two or three generations yet to come." This is not a flattering prospect except for two or three generations; afterward comes the necessity for the costly nitrogen, but by that time, Mr. Lawes says, the United States farmer will have become so well acquainted (the Western farmer he means) with the action of manures, that the profit or loss attending their application will not be subject to chance, but subject only to the contingency of favorable or unfavorable seasons.

I wish, for the sake of the worn-out lands of what is left of Virginia, such a millennium would arrive; for between Rothamsted and Vincennes and Bechelbronn the farmers are sorely puzzled. Mr. Lawes only sees from afar the promised land, the great West, and overlooks the intervening stretch of States likely to become a wilderness, if his views be correct, or only to be saved, like India, by the occasional death of

five or six million of nitrogen consumers—the survival of the fittest. We are in a most deplorable condition: our nitrogen is gone, and we have not yet attained that proficiency in science which awaits our Western brothers when they shall need the costly nitrogen. Again, we are handicapped, for the nearer we are to market the greater the cost to market the crop and the more it costs to get stores and farm supplies. It costs less, I am informed, to send goods from Richmond to Memphis than to Abingdon, 700 miles nearer. It costs more to produce wheat, more to place it on the market, while we pay more than the Western farmer for our supplies; and to cap the climax, the Federal Government lays an onerous tax upon our only money crop—tobacco.

The use of nitrogenous manures by the Virginia farmer is quite ruinous. The Western farmer fixes the price of wheat and corn and obtains his nitrogen from the soil, while the Virginian pays an enormous price for his nitrogen. But the cost is much increased when the fact is considered that the crop recovers only one-half of the nitrogen applied. It is stated by Ville that nitrogenous matter during decomposition suffers a loss of 30 per cent. nitrogen. Thus, if we apply nitrate of potassium or sulphate ammonium, only one-half of the nitrogen is recovered by the crop. If we use blood as the nitrogen purveyor, we must first deduct 30 per cent. for escape of nitrogen during decomposition; of the remainder, one-half only is recovered by the crop. Mr. Lawes says:

"Artificial nitrogen, in all its forms, is a very costly substance; and although it might be profitable to employ it, provided that it did all the work which was possible, still the difference between the possible and the actual result might turn the profit into a loss, while, unfortunately, the amount of nitrogen which may be lost is dependent upon such a variety of contingencies that it is impossible to lay down any rule on the subject. Let us assume that a crop of wheat fully supplied with mineral manures yields 12 bushels per acre, and that double that crop is wanted; 12 bushels of wheat, grain, and straw contain 19 pounds of nitrogen. Now, 100 pounds sulphate of ammonia, or 140 pounds nitrate of soda, ought to produce this increase; but we find that it does not, as our results show a loss of about one-half of the nitrogen applied. Whatever the loss may ultimately prove to be, the fact that a loss will occur must not be lost sight of in dealing with so costly a substance."

It is evident that our farmers will be ruined by purchase of nitrogenous manures; it is equally evident that a long series of cultivation has exhausted our soils to such degree that we cannot afford to *dig* for the nitrogen; our coal seam has been exhausted; to mine further is folly. The only thing left is to follow the advice of Horace Greeley and go West to the untouched stores of nitrogen. It has been often charged that the planters of old pursued a most ruinous system, cultivating to exhaustion and then clearing virgin soil; but let us no longer censure our forefathers, for their system has been justified by the researches of both Rothamsted and Bechelbronn, scientists. It is the system followed by the Western farmer who cultivates to exhaustion and moves farther west to well-filled garners of nitrogen. The Western farmer is doing with steam plow, reaper and binder and steam thrasher, what the Southern planter with his slaves did a few years ago. The West is leaping and bounding and booming, but vaulting ambition o'erleaps itself and falls. Well! Shakespeare did not tell us where it fell, and I will not make the attempt. I once heard a lecture by Mr. Fields, of Boston, in which he mentioned his visit to Carlyle. As he entered, the great Scotchman saluted: "Well, sir! is America going to the devil as fast as ever?" Mr. Lawes says that every immigrant is so much capital added to the wealth of America. Granted, if our object be to dig up our nitrogen as soon as possible; but otherwise (if Lawes' views of fertility be correct) he only hastens our arrival to the individual to whom, according to Carlyle, we are journeying, or to the undiscovered country whence no traveler returns.

Mr. Lawes' views have made a profound impression upon the agriculturists of our country, because they appear to be inductions from a system of long and well conducted experiments and careful analyses of soils. Indeed, it would appear that there was no escape from his conclusions, which ring the death-knell to the farmers of the Eastern States. All hopes of restoring fertility to exhausted lands must be abandoned, for the clover and pea, so far from being restorative, but hasten the exhaustion of the nitrogen.

But several propositions underlie his conclusions; (1) That his analyses afford a correct estimate of the quantity of nitrogen in the land under cultivation, and that all methods but his own of taking soil to be analyzed, are defective. Analysis of soil is one of the bases upon which his conclusions rest. (2) The nitrogen of the soil is in a comparatively insoluble state; otherwise it would be washed out of the soil. Hence he argues that plants feed upon the insoluble nitrogen, as he assumes they do upon the insoluble phosphates of lime and potash. I am far from denying Baron Liebig's views that a majority of our cultivated plants receive their nourishment directly from those portions of soil which are in immediate contact with their rootlets, although I am not prepared to accord with his opinion that they die when their food is presented

to them in solution, for he says, "It is very difficult to explain in what way plants act in causing the solution of minerals. As a matter of course, water is indispensable in the operation." Certainly many water-plants, whose roots do not come in contact with the ground, have their food presented in a state of solution, and on land abundant rains are necessary to fine crops. The ash of the duck-weed contains (see Liebig) 13.16 per cent. potash, 16.82 per cent. lime, phosphoric acid 8.73 per cent., and so on of his other mineral constituents. All were in a state of solution; its nitrogen must have been in a state of solution or derived from the atmosphere. These questions, I demur, are by no means settled; indeed, we find that Mr. Lawes (3) says: "Still it is not until the nitrogen of the humus has assumed the form of nitric acid that its full effect upon vegetation is realized. * * * Nitrification is due to the action of minute organisms in the soil." (4) Humus may be taken up more readily by some plants than by others. (5) We cannot rely upon analyses made by any other method than his own. The manner of getting the soil is as important as the proper conduct of the analytical operations.

ANALYSIS OF SOILS.

Too much importance, I think, is attached to results of analyses. The soil is ever active, ever changing. A few hundred grains of soil taken here and there and subjected to analysis cannot be relied on as sufficiently conclusive of fertility to base agricultural results upon, either for the renter or purchasers of land. I am much more inclined to rely upon the results afforded by experiments with plants than conclusions from laboratory analyses of soils. From one of Boussingault's analyses, the soil contained 38 pounds of nitrate potassa; from another, 911 pounds; from another, of the same soil, 1,290 pounds of iron nitrate; the different results being due to the conditions under which the analyses were made. Analysis shows that 17 parts of ammonia ought to furnish as good results as 54 parts of nitric acid, since the amount of nitrogen is the same (14) in both; but vegetation experiments do not bear out such a conclusion, since Ville has shown that the nitrates furnish more nitrogen than ammoniacal salts containing the same percentage of nitrogen, and that ammoniacal salts are inferior to nitrates in their producing power.

Nor do I attach as much importance to the loss from drainage as Mr. Lawes would have us do, as to balance the supply of combined nitrogen obtained from the atmosphere. The following analysis is a case in point, by Boussingualt: (1) After 14 days of hot and dry weather he found 911 pounds of nitrate potassa per acre taken to the depth of a foot. From the 5th to the 29th of August it rained daily, more than two inches of water fell; when rain ceased, (2) analysis, 38 pounds per acre. In September, rain fell 15 times; 4 inches of water. On the 10th of October, after a fortnight of hot, windy weather, the garden had become so dry as to need watering; (3) analysis, 1,290 pounds of the nitrate of potassa. Now, I ask what becomes of the opinion of losses by drainage? Had not the last analysis been made, we would have concluded that the loss of nitrate was 873 pounds. But 10 days of hot, dry, and windy weather restores to the soil 1,252 pounds of the nitrates, which I presume will not be attributed to nitrification. Yet Mr. Lawes tells us that it is a question whether, on arable land, as much or more may not be loss by drainage or otherwise, than is supplied by the atmosphere.

CLOVER IMPOVERISHES LAND.

He took a crop of clover from his unmanured plot after twenty-five years' cropping with wheat, and the succeeding crop of wheat was less than that obtained on a corresponding plot which had been under fallow instead of clover. He previously states the clover roots and other remains after crop has been removed, afford quite enough nitrogen for wheat following. I cannot understand, if clover be so vigorous a feeder on nitrogen, sending its roots into the subsoil, that it is one of the economic functions of clover plant to arrest and store up the nitrogen of the nitric acid of the soil, which would otherwise be drained away during autumn and winter—that his clover roots and other remains should not have afforded as good or better crop than the bare fallow.

On the other hand, Mr. Lawes says:

When a mixed manure containing a liberal supply of nitrogen has been applied once every four years since the commencement of the experiment, *not only was the amount of clover hay, as also the amount of nitrogen removed in it, nearly three times as much as that on the unmanured crops, but the crops of wheat succeeding the removal of the heavy clover crops have been heavier, and have contained more nitrogen than those from the similarly manured plots which were left fallow instead of being sown with clover.*

He tells us, however, on due consideration of previous illustrations, no argument can be drawn in favor of the assumption that the nitrogen of the clover crop was derived from the atmosphere. It is to be regretted that he did not give us the result of

analysis of soil before and after crop, and the quantity of nitrogen carried off by the clover plant.

Again, Mr. Lawes says: "It is true that there are some known circumstances in connection with the growth of the *leguminosæ* which are not inconsistent with the idea that they derive their nitrogen from the atmosphere; and if that view could be established as a fact these circumstances would certainly receive a convenient explanation. Among them may be mentioned the general indifference of such plants to a direct supply of nitrogen by manure, the benefit which they sometimes derive from an application of purely mineral manures, the increased amount of nitrogen in the surface soil after their growth, and the increased growth which they thus give to succeeding cereal crops."

These circumstances, he says, would receive a convenient explanation if that view (derivation from atmosphere of nitrogen) could be established as a fact. It would appear to me that these circumstances tend strongly to establish that view, if not otherwise accounted for. He answers thus: "But, on the other hand, the view in question entirely fails to explain why those leguminous crops which take up the most nitrogen, can be less frequently grown on the same soil; and why we have entirely failed to grow clover successively on ordinary arable land which was nevertheless in condition to yield fairly good corn crops; why the only condition under which we have been able to grow clover continuously, was when the soil was very much richer in nitrogen, as well as other constituents, than the arable land, and lastly, the growth under such circumstances has been accompanied by a rapid diminution in the amount of nitrogen in the soil."

These are cogent reasons for rejecting the view he is combatting; but he fails to tell us if leguminosæ are indifferent to supply of nitrogenous manures, leave more nitrogen in surface, and are so much benefitted by supply alone of minerals, whence they derive their nitrogen.

Mr. Lawes' experiments on *pasture* differ from those on arable land in the following important particulars:

"The produce of hay under a liberal supply of mineral manures has been greatly increased, and the amount of nitrogen removed has been very large, but at the end of twenty-five years there is no evidence of any decline in the produce."

It is true, he goes on to say, "that the nitrogen in the surface soil of the pasture shows a considerable decline, but with this exception there is nothing absolutely to prove that the atmosphere has not been the source of the nitrogen removed in the produce." It seems to me, if his analyses are to form the basis of deductions, that they should have shown that the nitrogen of the hay was equal to the diminution of that of the soil. But I infer that the quantity of nitrogen in the crop was much greater than that lost by the soil. Similar facts form the basis of Ville's conclusions, that the crop contains more nitrogen than is furnished by the manures, or, as in the above experiment, by the soil.

Mr. Lawes has not been able "clearly to establish by analysis that the subsoil of ordinary arable land, which has grown clover, is poorer in nitrogen than that of land which has been continuously under corn." It is, however, possible, as Mulder has suggested, that the failure of certain crops after long-continued cultivation in the same soil may be due to the exhaustion of some of these less-abundant and usually overlooked substances. Land not unfrequently becomes "clover sick"; that is, refuses to produce good crops of clover, even with the most copious manurings. In Vaucluse, according to Mulder, the madder crop has suffered a deterioration in quality, the coloring effect of the root having diminished one-fourth, as an apparent result of long cultivation on the same soil, although the seed is annually renewed from Asia Minor and great care is bestowed on its culture.—(JOHNSON, "How crops grow," p. 195.)

Mr. Lawes, in thus placing side by side the reasons which sustain each view of the nitrogen question, exhibits a fairness and justice which we had a right to expect from one who stands in the front rank of scientific agriculturists. But at the same time, I think that the settlement of the vexed question yet requires experimental research and observation. The settlement of the question is of great importance to the agricultural interests of our country. At present there is a widespread belief among the farmers of Virginia that the pea plant is an improver of land—a restorative. They can afford to buy the mineral manures, but not the nitrogenous manures. If, on the other hand, the pea is but hastening the exhaustion of the land, their system is quite ruinous. The same opinion prevails in regard to the beneficial effects of clover, and they point to large districts of land which were supposed to be exhausted, but which, by the use of clover and plaster, have become among the most fertile in the State. But all this must be a seeming fertility, like a goodly apple rotten at the heart, if the only supply of nitrogen be that which has been laid up in past ages. Much land has, in Tide-water Virginia, by the use of the pea and marl, put on this seeming or the appearance of fertility, like the hectic flush on the cheek of the consumptive. The soil is often shallow, 3, 4, 5, 7, or 9 inches in depth, under which is the "hard-pan," under this sand and gravel: often 7 or 8 feet below this, again, a bed of marl. Such land, I am informed, responds to the use of marl with clover and pea, returns good crops, and

seems to be improved. The late commissioner of agriculture of Virginia, Mr. Pollard, says in his report:

"Suffice it to say, it [the pea] is admitted to be a great improver, and there is scarcely any land in Virginia, no matter how poor, unless sand-banks, undrained lands, and rolling land which has had its soil washed off, that cannot be brought to a profitable state of cultivation by pea fallow and lime and marl, particularly if rye be conjoined, turning under both."

All such views need correcting if Mr. Lawes be correct, for the pea, so far from being an improver, has really been the means of exhausting the land; the pea has only rendered the nitrogen in the soil available for wheat, and your land is in fact poorer by the quantity of nitrogen removed by the wheat—19 pounds for every 12 bushels of wheat, grain and straw. But, on the other hand, is not the opinion of so large a number of farmers of some account in the discussion?

In considering the question how plants feed upon nitrogen, the structure and functions of the organs of vegetation deserve consideration, especially the anatomy and physiology of the foliage. Structure and function are interdependent; peculiarity of structure denotes special function, and conversely. Physiology treats of the machine in action and the forces which impel it. The peculiar structure of the leaf adapts it to the function of taking into its cells the gaseous constituents of the atmosphere, and the means by which certain products are cast off. Again, while there is a uniformity of construction of type in the foliage of all plants, yet we find certain differences in arrangement which indicate corresponding differences in function. The arrangement of the cells of the upper and under surfaces differ, and a purpose is subserved. Some leaves contain an immense number of stomata, others comparatively few. We are told that they range from 8,000 to 170,000 to the square inch. Some contain numerous stomata, both on upper and under surfaces; others few or none on upper surface. Some have a single row of cells on the upper surface; others two or more rows. In some the epidermis is thin; in others two or more layers of cells. We should, then, be prepared to expect variation in function in the leaves of different plants; for example, in wheat and clover plants.

In considering questions of physiology we seek for a reason in the structure and co-relation of parts; often physiological facts lead to discovery of arrangement which escapes the naked eye, and even the microscope. If Mr. Lawes' view that roots secrete matters which dissolve substances insoluble in water, there must be secreting glandular apparatus, which may or may not be reached by the microscope, for there must be correspondence between function and structure. The leguminosæ have structure which enables the nitrogen of the air to enter the cells of the leaf. The products thrown off by the leaf, according to Gray, do not contain as much nitrogen as is taken in—others say as much is given off as taken in by the plant. That chemical reactions take place in the leaf is admitted: carbonic-acid gas is decomposed and oxygen set free; oxygen combines in the plant with carbon, and carbonic acid is given off; water is decomposed, and the oxygen and hydrogen follow the bent of their forces. Formations and transformations take place until the architecture of the plant is finished and the cycle of life completed. In the words of another, "forces are active at the root, forces are active in the blade, the matter of the earth and the matter of the atmosphere are drawn toward the root and the blade, and the plant augments in size; we have in succession the bud, the stalk, the ear, the full corn in the ear; the cycle of molecular action being completed by the production of grains similar to that with which the process began."

But is there any verification of the inference to be drawn from the structure of plants and from chemical phenomena during vegetable life that plants feed on the nitrogen of the air? Epiphytes, or air plants, exhibit the peculiarity that, throughout life, they have no connection with the soil. "Of this kind are a large portion of orchidaceous plants of warm and humid climes; and to the family of epiphytic plants belong the Tillandria, or long moss, which, pendent in long and gray tangled clusters or festoons from the branches of the live oak, cyprus, and long-leaved pine, give such a peculiar and somber aspect to the forests of the warmer portions of our Southern States." Such plants draw their nitrogen from the atmosphere, for the combined nitrogen of the air is capable of furnishing only 5½ pounds per acre, and which is moreover washed out or dissolved by the rains. Time was when no vegetables or plants existed on the earth, but the earth, with its atmosphere, contained the potentialities of the vegetable kingdom. The first plants must have obtained their nitrogen from the atmosphere.

In regard to nitrification within the soil, the length of my paper does not permit me to discuss, but the opinion has been advanced that the nitrogen of the air is concerned in this operation. In my opinion this question deserves further investigation at the hands of chemists.*

* According to Saussure, the nitrogen of the air is concerned in formation of nitric acid within the soil in certain cases.

Longchamp is of opinion that organic azotized compounds have nothing to do with

In conclusion, if Mr. Lawes' views be correct, chemists must turn their attention to the atmosphere, and obtain nitrogen by some cheap method for agricultural purposes. There are millions in it. At present each season finds us with an increased demand for nitrogenous manures, and the increasing price is an increased tax on the capital and labor of the agricultural community. The basis of our grand country is a prosperous agriculture.

I beg leave to state that my chief object in presenting this paper is to elicit the opinions of scientific agriculturists concerning this important question.

The CHAIRMAN. The paper is now open for discussion, and the chair would be very glad to hear from gentlemen on the subject.

Dr. ELLZEY, of Virginia. Mr. President, no one else seems disposed to make any remarks upon this subject, and I beg to present a few thoughts of my own. The origin of the source of the nitrogen of plants I consider to be the leading question in agricultural science to-day. For years I have been endeavoring to enforce the question upon the attention of those engaged in the application of this science. Last year, in this body, I took up the subject, and urged the importance of having this Department give it due attention, and not only this Department, but agricultural stations and colleges throughout the country, because, as has been so well stated by my friend, this question lies at the very source of agricultural prosperity, and correct knowledge, therefore, is of leading importance to agriculture everywhere. There is very little to be added to what my friend has said concerning the state of the question to-day. Mr. Lawes has performed more service than any one else in this general line of agricultural investigation, but as yet he has failed to settle the question of the true source of nitrogen which is assimilated by plants, and there is no man living to-day who can answer the question in a definite and scientific manner. It is perfectly true that the efforts of scientists to prove the assimilation of nitrogen, whether by the leaf or by any other organ of the plant, have failed. They have made diverse and repeated efforts to demonstrate that nitrogen is so taken up and assimilated. That, however, leaves the question unproven—an evidence which is simply negative. Scientists have failed to show that this does or can occur; but they have also failed to show other things which do occur and have occurred, and therefore these failures of science do not establish the fact that it does not occur. The evidence of assimilation of the free nitrogen of the atmosphere by the leaf is very nearly conclusive to my mind, without undertaking to go into the detail of all the experiments that I have examined bearing on the subject. But as regards the origin of soil-nitrogen in its combined form, we are very much in the dark, and, notwithstanding all that has been said and written on this subject, chemists are ignorant to-day of what occurs in an ordinary nitre bed. We know that we find nitric acid, and nitrous acid, and sources of ammonia in rain-water, and we have our theories as to their origin in the atmosphere, but we are unable to demonstrate the correctness of those theories. We do not know whether it is thunder or lightning that produces it. There are agricultural facts, as they are called, which tend strongly to the conclusion that a certain class of plants obtain their nitrogen from some other source than the manure, and that is accumulated already in the soil—the leguminose, for example. We know that nitrogen in the soil passes at

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the formation of nitre, but that the water contained in porous bodies, such as chalk, absorbs oxygen and nitrogen from the air, and condenses them in the form of nitric acid.

The observation of Gaultier de Chaubry that a very large quantity of nitrates is produced in chalk hills, which contain but a trace of organic matter, is in favor of this view.—(GMELIN, Hand-book of Chemistry, II, 388.)

last to nitrous acid, and the loss of the latter is a very serious loss to the agriculturist.

[Dr. Ellzey then dwelt at length upon the importance of the National Department of Agriculture and State departments of agriculture, and colleges and experiment stations, taking up and settling these questions.]

Dr. Ellzey further said:

I have very little doubt myself that the ultimate sources of this nitrogen will be found to consist in the combined connection of the two classes of living organisms. The plants, the agricultural crop, the germ, the nutritive germ, are the chemical bases which are supplied by various moist bodies at a temperature varying from 60 to 95 degrees, and under these circumstances I think the proof is strong that atmospheric nitrogen does participate in the formation of nitric acid. We know that chemists are just beginning to learn something of induced chemical action; that is, chemical action of one sort which is set up in the progress of chemical action of another. Chemical action by induction is a new vista opened to chemists. My view of this supply is, that the inductive process is what is needed during the season of growth of these plants, whether we explain it or not. The agricultural facts demand an explanation, because the scientific facts now fail to explain that all plants which have a long season of growth do not in the least degree benefit by supplies of artificial nitrogen. We are beginning to hear about corn and tobacco. Tobacco-planters know that they need less and less supplies of nitrogen for tobacco, and that tobacco is able to take care of itself; that wheat grows after tobacco because of the accumulation of nitrogen during the growth of the tobacco. Every planter will tell you that. Now, I insist that these facts point strongly to the conclusion that these plants—that is, whole classes of plants—are able to get out of the atmosphere nitrogen itself, free nitrogen, and they are able in some way to force it into that sort of combination which will enter into nutrition. And I say, sir, as you have well said, that there is no more important question than this before the practical agricultural scientists in the world.

There is only one point in connection with the economy of fertilization which in importance approaches this, and that is as to the disposition of sulphuric acid in the treatment of phosphates. The latest information I have on that subject is, that the opinions of both Lawes and Voelkers, which have strongly inclined to the statament that the treatment by sulphuric acid is the most economical, have very recently undergone modifications.

I have letters from them within a week or two, by which it appears they have virtually abandoned the old theory that this may be reduced to a soluble form, and you can get it taken up and assimilated by plants freely, and that, if you can get rid of the nitric acid, you need have no further trouble. That is a matter approaching in economical importance the questions concerning these sources of nitrogen.

There is much evidence going to show that the ground which produces South Carolina phosphates is perfectly assimilable by plants. It is a point which affects the farmer and the whole industrial economy of the nation to a very important degree, and those charged with these duties are bound to take up that question and give light upon it. The most recent information I have is, that these things are entirely assimilable by plants, and it is doubtful whether they are in any degree benefited by sulphuric acid if ground as fine as it is now ground by manufacturers everywhere.

I am very glad that my friend brought up this question here, because there are no issues connected with the advancement of agricultural science or with agricultural economy that approach this in importance, and as they are not in a satisfactory state, the gentlemen charged with these duties should endeavor to make them so. I am not in accord with the honorable Commissioner when he says that science differs from practice in this connection. He spoke yesterday, as I understood him, of the differences between scientific and economic questions. Science is practice; that is my theory. What did Bacon say when he was laboring to overthrow the transcendentalism of the old school? "I am after fruit"—and that is my practice. Macauley well states that he believed in the science of philosophy which "began with observation and ended in fruits." That is the kind of science I desire to see in agriculture. I wish to see agricultural science put upon the basis of beginning in observation and ending in improved fruit culture and improved methods all round; and if you cannot do that, we had better abandon it. If agricultural science cannot at least answer this supreme question, what is it good for? That is the point to which agricultural science must come, in view of the particular circumstances and surroundings of man, wherever his land, wherever his markets, and whatever his crops may be. How may I best produce these crops in paying quantities and not exhaust the fertility of my soil? That is, after all, the supreme test of the value of your agricultural science. [Applause.]

The CHAIR. If no further discussion be desired on the subject, there is an article to be read by Professor Holmes, of the University of North Carolina.

Professor HOLMES. Mr. Chairman and gentlemen, at a venture, perhaps, I owe you an apology for occupying your time, considering the fact that there are so many older members of the Convention here who know more about this subject than myself. Yet it seemed to me there were certain points in connection with the development of the agricultural idea, in one section of our country, at least, which have not been touched upon. Ascertaining that no one here had offered a paper on identical subjects, I have, with the approval of the Commissioner, prepared a brief statement of the points as they occurred to me.

AGRICULTURAL EDUCATION IN NORTH CAROLINA.

By Prof. J. A. HOLMES, *of North Carolina.*

In the appropriation of the funds arising from the land grant of 1862, which gave birth to the majority of our agricultural colleges, and in the organization of schools in accordance with the conditions of that act, different plans were pursued in different States. But, though widely different in details, these plans may be classed under two heads: the first that of *isolation*, where what may be called a technical agricultural college was established, in some places assuming the nature and the title of a college of agriculture and mechanic arts; and the second, that of *annexation*, where a department of agriculture, or departments of agriculture and mechanic arts, were established in connection with and as a part of an already organized institution of learning. Established on one or the other of these plans, we have now in this country upwards of forty institutions at which are taught such branches of knowledge as underlie an intelligent agriculture, and in the majority of these instruction is given in practical agriculture itself, with the aid of an experimental farm.

It is not my intention here to enter into any general discussion as to the adoption of which of these plans more nearly fulfills the condition of the grant.

In phraseology of the bill itself, a wide latitude of interpretation was allowed, and in its rendering some States seemed to have availed themselves of the full limits of this latitude. The paper read in this hall yesterday on the manual-labor system of the Michigan Agricultural College, by President Abbott, and the discussion which followed that paper, brought out to some extent the methods adopted in Michigan, in the organization of its agricultural college, which may be said to have been estab-

lished on the plan first mentioned, that of isolation. It occurred to me that I might offer to the Convention a brief statement of the methods adopted in the organization of another of these institutions, which it has been claimed occupies an extreme position even among those organized upon the plan of annexation—the State University of North Carolina; and to state in this connection some of the difficulties which have been met and contended against in the development of the idea of agricultural education, and what seems to be the plan most likely to successfully overcome these difficulties.

The causes which have retarded the growth of agricultural colleges in this country have been so numerous that we wonder they have met with success. Nearly all of them have been established since 1862, and many were hardly in good working order ten years ago. A few even to-day are struggling for existence; and yet they are called upon to yield the results of mature and experienced organizations. They were established in time of social excitement and business depression, and from that time to the present our people in some sections have never ceased complaining of "hard times." Instead of being anticipated and demanded, many of them would not have been supported, and indeed would not yet have been established, had not the General Government offered a helping hand. And as the amount of funds derived from this source was in many cases small, several of these institutions have been driven to the necessity of struggling for life itself, while endeavoring to educate public opinion to an appreciation of their importance and value. Many of them have been compelled to set a low standard of entrance examinations, so that poorly-prepared and dull boys could enter, and have been expected to make good and successful farmers and citizens out of such material, and severely criticised if they failed to do so.

Another cause, of considerable importance, does not seem to have received sufficient consideration. *Applied* science cannot be successfully pursued or appreciated until some progress has been made in *pure science*. Nor will the individual or the people understand or appreciate the value of the application of science to the industries and arts until some knowledge of the science, as such, has been gained. The fact that our people have not welcomed or demanded the establishment of agricultural colleges is not difficult to understand. Many of them have long felt the need of something which would assist in bringing about a better and more progressive agriculture—something which would aid in bringing about the application of the best practices and the improvement of our existing methods; but that this something should assume the form of agricultural education—of agriculture taught to young men in a school—was not generally looked for. Even recently I have heard men holding the highest positions, in speaking of the establishment of a professorship of practical agriculture in one of our agricultural colleges, ask, "Why, what would a man holding such a position teach?" The land grant of 1862 does not specify exactly what branches of knowledge "relate" to agriculture and mechanic arts, nor the order of importance of these branches, but certainly the branches taught in nearly all our colleges and universities prior to the past one or two decades, are not those which are most intimately and vitally connected with the successful practice of agriculture. College statistics show that in the education of the majority of the men who now control our Government, and in educational institutions, comparatively little was taught or learned concerning natural sciences, and still less was said or heard about their practical application. The mass of our people learned even less about these sciences. Take botany, for example, which, according to our modern idea, has a direct and "vital" bearing upon agriculture. It has long been regarded as a girl's study, which men could hardly afford the time to investigate.

Where such conditions existed, viewed from this standpoint, it is not strange that agricultural colleges have not met with the hearty reception which may have been desired, that our legislators have been slow in coming to their support, and that in States where the colleges are liberally supported, the farmer, often looking on with a mingled feeling of indifference and criticism, has been slow to send his sons to avail themselves of facilities for study which such institutions may have afforded.

There have existed in our State conditions of society which have intensified these difficulties in the way of agricultural education and given rise to some additional ones. It will not be necessary, nor would it be desirable, to go into details here concerning the social system in the State, past or present. I wish to mention such points only as have had a direct bearing upon the question under consideration.

First, the young men of the State who from time to time have taken the advantages of a college training, have done so with the view of entering some one of the general professions. The exceptions to this rule were rare. If a boy were at all bright, and his parents could afford it, he was sent to college preparatory to studying for his profession; and, so far as I can learn, the custom has been, if the boy was not considered bright enough for this, he remained at home to become a farmer or business man. College studies were adapted to suit the wishes of students who attended, and such studies were taught as answered the purpose of a general training.

For many years prior to 1860, the instruction in natural sciences was confined to

short courses in theoretical chemistry, physics, and geology, with little more than a mention of other branches. The instruction in mineralogy, zoology, and botany could have been given in a few lectures, one or two devoted to each of these subjects. It is hardly necessary to remark that in this brief review little could have been said about the practical application of these branches.

Men educated under such a system—the intelligent, leading men of their communities—probably had a general notion concerning the connection of the natural sciences with agriculture, but such a notion must have been far too general and vague to have assumed a practical form.

And, second, the effect of such a system acting with other forces upon the agricultural progress in the State can be clearly seen. The men in immediate charge of the farms, the majority of whom did not receive the benefits of the college course, were not trained to observe and study the problems connected with agricultural advancement; and when the college-trained men turned their attention to agriculture, as they often did in a general way, they understood but little more about the modern methods which are growing out of, or stimulated by, the study of natural sciences. Their education was incomplete at a vital point, so far as successful progressive agriculture was concerned. They had been taught neither the necessity nor the methods of accurate, careful observation and experiment, all of which are so essential to success in any industry. As a result of such a system, men engaged in agriculture were not constantly on the outlook for aid from other branches of knowledge; they did not study their profession with that eagerness to take advantage of every new idea, every new method or invention of their neighbor, their neighboring community or country; and agriculture as a whole, under this system, did not make the progress which it might, had circumstances been other than they were.

And, thirdly, the reaction of the condition above alluded to upon the growth of the more recent idea of agricultural education, is important in our present consideration. This was referred to in the earlier part of the paper, but there are a few additional points in connection with the effect it has had upon the views of our people with regard to agricultural education, and the influence these views must exert upon the growth of an agricultural college, which should not be overlooked. From answers to inquiries made of intelligent men, I venture the assertion that the State has not up to the present time been ready to support, either by appropriation of funds or in students, a technical agricultural college, such as is in successful operation in Michigan and a few other States.

The ideas of a people concerning a subject like education do not often change rapidly. For three quarters of a century, college education in the State has meant a general literary education, and to-day, as a rule to which exceptions are rare, when citizens, including farmers, can afford to give their sons the advantages of a college education it is the desire of both father and son that the course of study pursued should be a general literary course. I have heard a good deal said in a general way about the value and the need of agricultural education in a section of country where agriculture is the almost exclusive industry of the people—statements intensely true; but I venture the assertion that the sons of the very authors of such a statement will be found, when they enter college, to take the general rather than the special courses.

In making these statements I do not lose sight of the fact that there has not yet been established in the State a special agricultural college, and that hence the farmers have had no opportunity of seeing the practical workings of such an institution; nor do I wish to intimate that the idea of agricultural education is making no progress. We are here, as in other respects, in something of a transition state, the future of which, I am glad to be able to say, seems brighter than the past. While the ideas of even our more intelligent men, with regard to the matter, are as yet very general, they promise better for the future. Our farmers, while not yet ready to confine the education of their sons to such a course as is given in the agricultural colleges or departments of agriculture of other institutions, are nevertheless beginning to desire that they learn something about branches related to agriculture. But that "agriculture" can be taught in a college, and that to be a successful farmer requires an extended education other than such as is gained on the farm and public schools, are ideas which, when expressed at all, assume the form of rather vague generalizations.

It is unnecessary to add anything here concerning the *need* of agricultural education. Such a need may be said to exist to a degree inversely as it is felt and appreciated. Our people are essentially an agricultural people. Not the farmer alone, but frequently the attorney, the physician, and even the clergyman sometimes own farms and superintend their management.

Such being, as I believe, some of the facts of the case, the important question to be asked is, *What kind of agricultural education* is best suited to this transition state of our people? Clearly, in nature it must not depart too radically from the long-accepted views of the people concerning education. In the first place, I will venture to state that a strictly agricultural college would prove a failure, because it would not

receive the financial support of the people. The income from the General Government fund would be too small for its support, and little aid could be hoped for from private individuals. If such an institution had a good financial support, the number of students would be small, and the usefulness of the institution would thus be greatly limited. In this latter case, however, I should not be so ready to complain, because I am not prepared to accept the sweeping statement, not infrequently made, that many of our agricultural colleges and agricultural departments of other institutions are failures because they have, at first, few students in attendance.

And in the second place, the modification of the courses of study of an already organized working institution so as to include in all of them instruction in natural sciences and the relation of these and other studies to agriculture, as has been done in the State's university, and the later addition of a department of practical agriculture with its experiment farm, seems to be the plan most likely to meet with success. Such a plan more nearly meets the wants of the general student expecting to follow one of the professions, and who yet finds it useful to know something of the principles of agriculture, and at the same time the student who expects to devote himself to farming exclusively. Believing this plan the one most advisable to adopt, the university is following it as closely as funds at its disposal will allow. Chemistry, physics, engineering, and natural history, studied in their relations to agriculture, are required in full in one course, corresponding very nearly to the agricultural course at other institutions; in part required and in part optional in the two general courses of study. The university up to the present time has offered very little instruction in practical agriculture, and has not an experiment farm in working operation, though some experiments have been conducted on farms in the vicinity. Plans are now under consideration which have in view the addition of an experiment farm and an instructor in practical agriculture to teach and to take charge of the farm.

The university does not claim that it has carried out in the past, to its full extent, the spirit of the land grant concerning agricultural education. It is aware that in addition to giving instruction in branches related to agriculture, it should have given instruction in practical agriculture itself, and, as a part of such instruction, should have had an experiment farm in operation. But it felt that it was impracticable to undertake these extensions with limited income at its disposal. The question has been here, as at many similar institutions, was it better to endeavor to carry on everything from the beginning with limited funds at its disposal, or to do more thoroughly the work already undertaken, and to add to the curriculum other branches as rapidly as an increased income would allow? The latter policy in this case was thought to be the more practical.

Professor HOLMES. Now, gentlemen, as I stated in the beginning, the institution of which I have spoken is one that has occupied the extreme of that liberal movement. If, under the circumstances, it has not pursued the best policy, none would be more glad to hear the criticisms upon that policy than those connected with the institution itself.

Commissioner LORING. Before any discussion is had, I desire to make a statement in regard to what has been done here relating to the experiments with nitrogens; that is, the sources of nitrogen as a stimulus for plant-growth. The question was discussed pretty largely, as some of you will remember, at the convention of last year, and Professor Atwater, who brought the matter before the convention, supplied me with a pamphlet which I published with this note touching it:

DEPARTMENT OF AGRICULTURE,
Washington, D. C., March 27, 1882.

SIR: I submit for your consideration the following suggestions with regard to plants and fertilizers, which were laid before this Department by Professor Atwater at the agricultural convention held here in January last.

I consider it very important that these suggestions should be put to a practical test, and I shall feel under great obligations if you will establish a series of experiments upon the plants and fertilizers herein enumerated, and will submit a report thereon to the Department with as much care and elaboration as you can without interfering with your duties or with the work which you have assigned yourself.

Very respectfully,

GEO. B. LORING,
Commissioner of Agriculture.

The object of this pamphlet was to ascertain not only the effect of nitrogenous fertilizers, but, if possible, to inform us of the sources from

which plants derive their nitrogen which they do not get from fertilizers, and the experiments were very carefully carried on. The preliminary essay of Dr. Atwater dealt with the feeding capacity of plants and experiments upon the effects of nitrogenous fertilizers. The object of these experiments was to test the effect of nitrogenous fertilizers upon the growth of plants, and inform us of their capacity to get their nitrogen from natural sources. The following was suggested as the general line of investigation:

Experiments upon the effects of nitrogenous fertilizers.
The feeding capacities of plants.
The effects of nitrogenous fertilizers upon corn.
Feeding capacities of other crops.
Experiments with cotton.
The effects of phosphoric acid in different forms of combination.

Now, on these instructions, which were elaborated in tabular form, blanks were sent with this pamphlet, with details of the experiments on one side and blanks for reports on the other.

There have been received eight replies to this circular, from the following gentlemen:

Prof. W. C. Stubbs, Alabama Agricultural and Mechanical College, Auburn, Ala.; Edward Hicks, Old Westbury, N. Y.; Prof. C. L. Ingersoll, Purdue University, La Fayette, Ind.; Prof. Samuel Johnson, Michigan Agricultural College, Lansing, Mich.; W. C. Newton, Durham, Conn.; J. W. Pierce, West Millbury, Mass.; C. E. Thorne, farm manager, Ohio State University, Columbus, Ohio.; J. M. Manning, Taunton Mass.

Now, you will see that the statements are made by very honorable men, and the results reached, in pursuance of instructions laid down in this pamphlet, are of great interest, and just that kind of interest that would attract the attention of scientific men and lead to still further investigation as to how far the plants derive their nitrogen from fertilizers, how far from soil, and from other sources. It is a very difficult thing to reach. The experiments tried must necessarily be very diverse, and the investigation, when we get beyond the soil and fertilizer, which are material things, is still more difficult to enter into.

I have brought up the matter here because I thought that as this question was under consideration, the Convention would be interested to know that these experiments had been entered upon, and perhaps would be glad to know also that these blanks and pamphlets are still to be obtained, and that the increase of these experiments would result in a great deal of profitable information. I would be gratified indeed if any gentleman will call upon me or my secretary, Mr. LaDow, for a supply of these blanks and the pamphlets that go with them. I would be much pleased to furnish them. I have an impression myself that the fertilizers which are supplied to us artificially and naturally, are sources of nitrogen enough for all practical purposes. I presume that the fertilizers alluded to in the paper I have read are sufficient for all the purposes of agriculture. They are all we can control. At any rate, they are all we can lay our hands upon, and everybody knows that however good a horse you may have, if he runs away with your buggy he is worse than no horse at all. You want to guide, to control, to govern the forces of nature, and not to rely upon the uncertain, subtle, and hidden forces which nobody exactly understands, and nobody can possibly control. The vast number of artificial fertilizers, night-soil, &c., which you get around the large cities, furnish nitrogen enough for any plants that you desire to grow. The enormous growth of cabbages, onions, and such

plants, are forced by the abundant supplies of nitrogenous manure obtainable in and about our large cities. I have stated this that you might have a complete idea of what has been done, because Professor Atwater is a thoroughly scientific and enthusiastic investigator.

Professor WILEY. Mr. President, would it be in order now to say something in regard to the paper last read? I was very much interested in the description of what was doing in North Carolina. I desire to say something in general of what we are doing in our own State, and I wish to say it in a little extract that I will read from an address of the president of our Agricultural College, Dr. E. E. White. In the address, delivered about eight months ago, Dr. White summarizes what is doing in the agricultural colleges in the United States, and it just comes aptly in connection with what Professor Holmes has said in his paper, except that he carries the analysis a little further. I will read this analysis for the information of the members of this Convention, because I doubt not they will be very much interested in what is here stated:

[EXTRACT.]

The plans adopted for carrying out the great purpose of the grant may be classified as follows:

1st. The organizing or endowing of scientific or industrial departments in existing classical institutions, as in Connecticut, Rhode Island, New Jersey, Vermont, North Carolina, Wisconsin, Minnesota, Missouri, California, and several other States.

2d. The organizing of new universities, as in New York, Ohio, and Illinois.

3d. The endowing of existing agricultural colleges, as in Michigan, Pennsylvania, Maryland, and Iowa.

4th. The organization of new colleges of agriculture and the mechanic arts, as in Maine, New Hampshire, Virginia, Kentucky (detached from State University in 1878), Kansas, and several other States. In Massachusetts the fund was divided, two-thirds being appropriated to found a new agricultural college at Amherst, and one-third being appropriated to the Institute of Technology at Boston.

5th. The organization of a new college of science and industry, with scientific, agricultural, and mechanical courses of study, as in Indiana.

The adoption of these several plans of organization has been more due to circumstances than to any intrinsic merit of the plans themselves. In Connecticut, New Jersey, and several other States, there already existed in existing colleges fairly-equipped scientific schools or departments, more or less distinct in organization, and the Congressional grant was used to strengthen these departments; but to prevent the funds from being diverted to classical or literary studies, they were in some instances separately invested, and exclusively devoted to scientific and industrial purposes. The fact that separate agricultural colleges already existed in Michigan, Pennsylvania, Maryland, and Iowa caused the funds in these States to be appropriated to these institutions and used almost exclusively for agricultural purposes. In New York the large national fund was supplemented by the munificent gift of Ezra Cornell, and the new institution assumed university proportions. The existence of the Indiana State University at Bloomington permitted Purdue University, though bearing a university name, to confine itself to the important work outlined by Congress, and it is believed that no other land-grant college conforms more literally and fully to the terms of the Congressional grant. It is at once a college of science and a school of technology, science being made the basis of its technical training. Its central aim is to prepare men to lead in the application of science to agriculture and the mechanic arts—to send forth well-trained scientists, agriculturists, and mechanics to promote the great industrial interests of the State.

We cannot stop to discuss the comparative merits of these several dispositions of the national grant, and we have no desire to make invidious comparisons of the institutions that have received the funds. Some of the institutions have excelled as schools of science, and others have given almost exclusive attention to agricultural education, general and special. Few have given due attention to technical training in the mechanic arts, but this defect is being corrected.

It seems proper on this occasion to inquire to what extent these national industrial colleges have realized the great purpose for which they were founded. It is now twenty years since Congress set apart a large proportion of the public domain to found colleges "for the benefit of agriculture and the mechanic arts," and time enough has elapsed to justify the popular demand for practical results.

The sources of information are certainly adequate for safe conclusions. The annual reports, the publication of which is required by the Congressional act, contain much valuable information. Investigations have also been made by Congressional committees appointed for the purpose, and the results embodied in reports to Congress. Several of the reports of the United States Department of Agriculture devoted considerable attention to the agricultural work of these institutions, including instruction, experiment, model farming, etc. But, next to the annual reports and catalogues of the institutions, the most satisfactory and trustworthy sources of information are the sev- reports of the Bureau of Education from 1868 (the first issued) to the present year. each of these reports contains the statistics of the land-grant institutions, with statements of the improvements made, courses of instruction, and other information more or less complete. The report of 1871 contains a special report prepared by Prof. D. C. Gilman, then of the Sheffield Scientific School, Yale College, now president of the Johns Hopkins University, Baltimore, who had been specially commissioned by Commissioner Eaton to investigate and report upon the conditions of the various institutions endowed by the Congressional grant. This report covered only the first nine years of their history, and was necessarily largely devoted to the financial results of the grant, to State legislation, the organization and equipment of the institutions then established, the character of the instruction proposed, etc. It was too early to give results, but the interval which has since elapsed has been sufficient to change what was then only promise into actual performance, and it is hoped that the national bureau may renew this investigation and carry it forward to the present time.

In anticipation of such an inquiry, it may be safely said that the results actually accomplished by the national grant in the two decades now closing are not satisfactory, though promising more complete success in the future. The best results thus far attained have been in the direction of scientific training and investigation. The founding of the national school has caused the study of science to assume new importance in all higher institutions, and a greatly increased number of students are taking the so-called scientific courses of study. Radical changes have also been made in the methods of teaching science, and enlarged facilities for scientific study and investigation have been provided.

The most unsatisfactory results are in technical training, both in agriculture and the mechanic arts. The contributions made to agricultural science have been small, and the promising work of agricultural experiment is still in its infancy, even in the institutions first organized, and in most of them it has not been seriously undertaken. Comparatively few students have taken distinctively technical or industrial courses, and the small number of well-trained technologists sent into the industries of the country is at once a surprise and a disappointment. The great majority of the students receiving either an agricultural or mechanical training are found in the few institutions which have only industrial courses of study.

It is not difficult to account for this unsatisfactory progress in industrial training and investigation. The importance of technical education for the farmer and artisan are not generally realized, and, as a consequence, the demand for such training is limited, though happily increasing. There have also been a low appreciation and an imperfect knowledge of industrial methods, and this has not only been true of patrons and students, but also, in many cases, of officers and instructors. As a matter of necessity, the new industrial schools have been largely officered with men who were educated in the classical colleges, and hence had little knowledge of technical training and perhaps less faith in its value. As a natura lconsequence, in too many of these institutions, the main work has been in the traditional grooves, and their industrial effort has been superficial and inefficient, if not shammy.

The difficulty in securing instructors, trained in applied science and technical methods, has been one of the most serious obstacles which these colleges have encountered. The number of men in the country qualified by education and experience to fill an agricultural chair is not now sufficient to supply one-half of the industrial colleges now organized, and ten years ago the supply of such men was still more limited. The older technical schools were obliged to train their own instructors, and this fact greatly retarded their progress.

The above facts show why the controlling, dominant influence in so many of the land-grant colleges has been classical, not industrial, and why the central strong current of opinion, desire, and effort has so often been away from the industrial and toward the professional life. Even when the leading idea of the national college has been industrial, its development has been impeded and its progress choked by customs, practices, and other hindrances copied from the classical system, many of these being poor imitations of the stale mummeries of the old aristocratic universities of Oxford and Cambridge.

Professor WILEY. It cannot be denied that this is a very fair statement of what the institutions are doing. I believe the prospects for technical education at these colleges are brightening, and that such

education is necessary. I think that too much attention has been given to classics, and too little to technical training which the law of Congress requires. It has not been two years since efforts were made to force upon my college (Purdue University, Indiana) the classic study of ordinary colleges, and these were coupled with threats to break up the institution. This idea had been supported, strange to say, by people in the immediate vicinity, notwithstanding the fact that the State already had a State University. Of course this did not carry, but just note the sentiment which could induce a body to entertain such a preposterous proposition. I think we need not be discouraged. The people will soon see the importance of confining these institutions to the purposes to which they were designed by act of Congress. I wish, while I am on the floor, to correct a misunderstanding with regard to Commissioner Loring's position. The gentleman from Virginia (Dr. Ellzey) stated that he (the Commissioner) wishes to divorce science from practice. Now, if I properly understood the Commissioner's remarks, just the opposite is the case. He wishes to bring about a more intimate, sympathetic union between practical science and practical agriculture, and it is plain this is one object he had in view in calling this Convention together.

In regard to the source of nitrogen in plants, agriculturists have left out of consideration, so far, the result of the very elaborate experiments made by celebrated French scientists to discover whether or not a body can assimilate nitrogen from the air, and it seems as the result that even a dead organic body can be made to assimilate nitrogen from the air, and convert it into a form to be taken up by plants. It seems to me that the earth and air are in opposite electric conditions, and that these are extremely favorable to the formation of ozone, and that these, producing ozonizing effect, cause a constant working on the nitrogen of the air, thus enabling it to pass into the condition of nitric acid or some form of combination by means of which it can be assimilated by plants. I am fully convinced from experiments made by myself, and from what I know of other experiments, that this is constantly going on. I do not think it is necessary to have a crash of lightning through the air to establish these relations, but that it takes place constantly, and near the surface of the earth, where the ammonia and nitric acid can be readily assimilated by the plant.

Professor KNAPP, of Iowa. There is a feature in this body which ought not to be left to pass unnoticed, and cannot be without doing injustice, it seems to me, to our agricultural institutions. I infer, though it has not been directly stated and charged, there is a belief on the part of the public that there have been shortcomings in the organization of the several institutions, by which they have failed in part or in whole to produce the results expected of them. Now, in justice to the institutions, I desire to state briefly some of the difficulties which surround them. One of them, and a very great one too, is that the public expect far more from them than they are able to accomplish. They are asked first to carry on student labor—a very noble thing—to keep the student in harmony and sympathy with the great industries of the country, to keep the muscles, so to speak, attuned to industry, so that the student by the work of his muscles may not flow away from the industries and enter into sympathy with sedentary pursuits. Now we find, when we come to the practical application of this principle, that it involves very great difficulties. After a most careful analysis of some of these difficulties, and while I favor student labor, I must say that it is immensely expensive. I think, if it is conducted as an educational process, the cost is nearly equal to the value of the labor performed by

the pupil, and so you may count the entire amount paid to the pupil a total loss financially to the college. Now, on the other hand, people say not only shall you carry on this industrial labor, but the farm must be made to pay. The result must be determined. "What is the use of science," they say, "if you don't make it pay?" There you come to the self-education. You must use this labor in an educational way, you must pay the student a reasonable compensation, and then you must have a profitable farm. Then there is complaint in another direction; that every year among the number of graduates there are few in proportion who return to the farm. In some colleges with which I am acquainted more than 50 per cent. of all the pupils who attend the college and are benefited by the curriculum return to the farm, but the percentage is small with the graduates. And why? Because the young men attracted to the college are mainly poor, and they are first interested in the great economy and possibility of paying a large proportion of their expenses by manual labor. A grand thought, a grand ambition, Mr. President, and it gathers to these colleges the grandest lot of students perhaps in the nation for character, for industry, for energy, and for ripe scholarship; and the leading students of these colleges are the boys who are working their way through without a dollar to back them. Now, what are you going to do with such a young man? He is a man of sense, and when he gets through and graduates, he indulges the hope of accomplishing something better, financially, than $20 a month, and unless there be an opening for foremen or managers of large estates, he is forced by necessity to enter upon some other pursuit for a livelihood.

The next charge made against colleges is that they do not know much about farming, and the old farmers, with a good deal of pride, will begin to quiz them, or, as we say in the West, "prod" them upon certain points, and, because they are not posted upon every practical branch of education, they do not amount to a snap of the finger, they say, and there is nothing practical in them. They suppose that scholars should come from the college, after four years' education, the very embodiment of all agricultural wisdom. That is the mistake. They ought not to expect it. It is impossible to give them very much technical education within the four years' time. They must have a broad and well-founded education before they can be taught to apply great fundamental principles. I ask, in the freshmen year, "What is agriculture? Is it not applied science?" "Yes." "How am I to apply science until the students get science?" "Oh," they say, "but there is time in the senior year." Very well; it is not for me to say when. It is my province to teach and apply science, and I must, out of respect to myself and to science, see that they have that before I attempt to apply it. Now, I say that the question of general education has absorbed every attention.

Then there is another difficulty, and one to which I wish to call the attention of the farmers of Iowa. They met me in our stock convention a month ago, and came forward with the old question, "What is the reason that so few of the graduates of our college return to the farm?" "Well," said I, "there are a good many reasons, but I will tell you one. The farmers don't want them to return to the farm." Out of 280 students who attended our college—male and female—during the past year, perhaps I ought to include the ladies who return to the farm, because their returning there depends entirely upon circumstances [laughter], but out of 200 young men who attended our college we had between 50 and 60 technically agricultural students—young men who were there pur-

suing special lines of agricultural study, with a view to their practical use upon the farm, in connection with their general studies. Who were they? In the first place, I will tell you who they were not. Not one of them came from the class of farms where the love of farm life had ever been taught. On the contrary, they came from that class which dislikes farming, and where, perhaps, owing to the intensity of toil, and the lack of pleasant surroundings, the mother had been so imbued with a dislike of the farm that she was constantly inspiring her boy with the ambition of becoming a lawyer or something else. Who were the young men working with a view of returning to the farm. They were the sons of successful farmers; the sons of men who have made the calling of agriculture an honorable one in the land—the successful dairymen and the successful stock-raisers. I pointed in that convention of 500 men to one man, whose son came to us with a view of returning to the farm, and who was studying technical agriculture. Who was he? He was a man who came to the State in his youth, and who has accumulated over $80,000 by successful agriculture. He stated there that he took 80 of the leading papers of the country. His farm was covered with the best short-horns, the best stock, the best herds. Very naturally, the young man thought that farming was a success. It meant intelligence, it meant honor, it meant wealth. On the other hand, the young men were taught this light farming, and the most sarcastic talk about mudsills and about hay-seed emanated from those who came from this inferior order of farmers, which has some way obtained the idea that farming disgraced them, and they would willingly sell out their farms, drive a horse and dray, and think themselves nobly occupied at last. From that class of farmers, we can never hope to receive encouragement for technical agriculture. It is "died in the wool" that they will not be technical agriculturists; but the class of young men from which we will recruit our members in technical agriculture are those who come from homes where prosperity has prevailed, where culture has reigned, and where science has been achieved, and I am glad that the number of these is increasing every year. [Applause.] It is doubling every year. [Applause.] A man says to me, "I have several farms; I have a son; I want him to learn to manage those farms." Those are the young men to bring into agricultural colleges.

I have given these few reasons; if I should go over them all I would trespass upon your patience. But in defense of these colleges, and their lack of success, I wanted to throw out some of these suggestions. It must be remembered that the colleges did not, at first, fully understand what was expected of them. The idea of making this endowment to the States was a grand conception. The States accepted it, but when they came to embody it, erect their colleges, and get some one to preside over each, who could they find? It was a new departure in the line of education, and different States searched for years before they obtained the proper men. We had had no experience in that kind of training, and therefore immediate progress ought not to have been expected. I think when measured up, considering the period of time and the conditions under which they have been placed, they have made reasonable success, and that our people ought to be forbearing and long-suffering, and give these colleges their encouragement. Here is a professor of agriculture, established as an instructor. They expect him to superintend a large farm in the first place, for in our country, you know, upon a farm of 900 acres no foreman is necessary. This professor was such a broad man that he was expected to simply spread himself and hatch two barrels of eggs. In the next place, he is expected to carry

on a full line of experiments, to establish chemical results, and everything else, with no chemicals at his command. Do you doubt that it requires force on the part of such a man to organize, and vast powers of perception to grasp, and energy to carry through such a work? In the next place, we had no text-books. It is singular that the greatest number of text-books are written about things we know the least about. Take a catalogue of our public libraries. There will be the greatest number about heaven, and the least about agricultural subjects. [Laughter.] The necessary and proper text-books are not to be had, and it will require the next decade and more to produce them. So, without books and without men, but with great expectations upon the part of the people, and little accommodations on our part, what could we do? We have done our best: we have given our best service to the public, and they must accept us as we are. [Applause.]

A DELEGATE said that one of the things which had contributed to the partial failure alluded to in the address of Professor Knapp, was the effort to supply a school for poor boys, and education of a high order could not be cheap. It ought to be decided whether the colleges are going to furnish an education of a high order to the boys who will profit by it, or whether they are to supply a sort of half education to a lot of boys just because they need it. The class of boys who go to these institutions, and after graduating serve as engineers or clerks, or to drive the "horse and dray," is not going to revolutionize agriculture. The young men who *are* to revolutionize agriculture are those who come from well-to-do farmers; they deserve education of a high order, and you cannot give it them unless you incur the necessary expense. With regard to the course of instruction, the speaker thought the sooner it was decided how much of the old curriculum should be thrown aside and the sooner a sharp, well-defined system was inaugurated, the sooner some of the difficulties referred to would be overcome.

Professor HOLMES. When young men enter these colleges the practical question of their general education comes up; but the organization of the college is a professional one. The medical college does not concern itself about the classic attainments of its student, and so, in the case of the agricultural college, young men ought not to go there until after they obtain a fair education, and then they might attend the agricultural college and devote their time wholly to professional training. The public expectation is extravagant and out of all proportion to what is possible. The difficulty is not and has not been appreciated by the public. A young man goes out with all the information possible to give him on agriculture in three or four years, and he would never make a manager or overseer, because the success of that management depends upon capacity for administration, upon experience, upon business tact, upon those things not obtainable at college. No one will trust a common college boy with the management of a farm. The profession of farming is far more difficult to teach and acquire than any other. There is no business which involves so much capacity as the successful management of a large farm. It is true that college graduates who returned to the farm are mainly sons of well-to-do farmers, and the organization should pay no attention to the other things if they do not wish to go through and have their students take advantage of them. In regard to the labor question, every one must admit that student-labor is expensive; but the idea ought not to be to make a profit out of such labor. The sooner the idea is gotten rid of that young men cannot work their way through college by the labor system, the better it will be for all. I can name many who have come up from homes of poverty to what they

now are by physical and mental activity. The work should be educational, and not for supporting but for training the student. The millstones that some of these colleges carry around their necks is the idea of profit and cheap general education for a number of boys. These should be separated, and then the colleges will do good, and go forward with more rapid strides to the end held in view.

Mr. PAGE, of Virginia, referring to the question as to what young men are to do when they graduate, said that they go to an institution where there are several acres, each of which is fully occupied. There is a variety spread before them, and they have the opportunity to choose. Of course, the practical question is: "Engineering, architecture, &c., pay $75 to $100 per month; what does agriculture pay?" They naturally accept the best paying avocation, unless they come from farmers who own farms, where there is a prospect of their succeeding to those farms, and they will do this in spite of all the instructions and pressure that can be brought to bear.

The discussion was continued for some time, being participated in by Messrs. Conrad, Page, and others, and at 5.30 p. m. the Convention adjourned.

THIRD DAY.

THURSDAY MORNING, *January* 25, 1883.

The Convention was called to order at 10.20 a. m., Mr. Coffin, one of the vice-presidents, in the chair.

The credentials of Hon. Ed. McIntyre, to represent the Nebraska State Board of Agriculture, were received and filed.

The CHAIR. The Convention will come to order. The first paper set for this morning is one by Mr. Baker, of Ohio, on "The Best Breeds of Cattle for Farmers in the Western States."

Mr. BAKER then presented the following paper:

BEST BREEDS OF CATTLE ADAPTED FOR THE GENERAL FARMER OF THE WESTERN STATES.

By R. BAKER, *of Ohio.*

Many farmers of the Western States have their minds settled as to the kind of cattle they prefer. Some have a fancy for those of the Channel Islands, as they are up to the highest standard of excellence in their estimation for dairy purposes. The Ayrshires have their admirers, who claim they cannot be excelled for milk. They even go further, and contend that they will fatten easily. The Holsteins have been imported to some extent, and are claimed to be perfect milkers; that they fatten easily, and their beef is of fine quality. The Devon has also its admirers, and the many good qualities of this breed make it, in the opinion of many, best for all practical purposes. As to the Herefords, there is not a man breeding this class who does not claim them to be superior to all other kinds, insisting that they will prevail all over the States. There are also the hardy Scotch breeds, the Aberdeens, Galloways, and West Highlanders. Each of these, whose importation has been of recent date, has many good qualities.

Then come the Short-horns, by many called the "noble Short-horn." Some breeders claim that they are best adapted for dairy purposes, while others, equally interested, insist that their place is for beef.

In selecting from the above-named breeds, we may find it difficult to narrow down to one, two, or even three of them. All may be profitable in some locations to a certain extent. It is not my intention to advocate a breed for a few, but such breed or breeds, with their grades, best adapted for the general farmer of the Western States. Those breeds that are adapted for milk and butter alone cannot be the best for general purposes. The Jerseys, Guernseys, Ayrshires, and Holsteins may be profitable to

those breeding for sale and also in some city dairies. The small size of the Jersey, the docile habits of this and other breeds from the Channel Isles, adapt them for the paddock and parks of the rich or for a city family cow. Their cream and butter cannot be surpassed.

The Scotch breeds, Angus or Aberdeen, Galloways, and West Highlanders, the two former hornless, are a hardy, useful beef animal, and for the colder regions and on low-priced land can be used to advantage. Their beef is "No. 1," being quoted the highest in London market. The lean is nicely marbled, and very juicy, and there is more lean in proportion to the fat than in many other breeds. Their slow growth and later maturity are objections for the rich and valuable land of Ohio, Indiana, Illinois, Iowa, Michigan, and some other Western States, but for the plains and for the West, their hardy constitution and extremely good beef qualities strongly recommend them. For Texas, to reduce the long horns and legs, and give to the large herds of that State a more compact and salable carcass of beef, they would do good service. The Highlander is equally hardy. It is a good feeder, and produces rich, marbled beef, but carries long though handsome horns.

The Hereford is a hardy, useful animal, and, where beef is the only object, will answer. They will fatten easily on good pastures, and compare with or surpass almost any kind to be sold direct from the pasture, but for winter-feeding in the States they are not so well adapted as the Short-horns. The bulls of this breed have been in great demand for the plains for two or three years past, and the demand is not abated at the present time. Whether such demand will continue remains to be seen. Their hardiness and prime beef qualities will give them a prominent place as a profitable breed for the Far West.

We come now to the Short-horns. This class of cattle has been successful for generations, pre-eminently meritorious as milkers, as well as for beef. They have succeeded in northern countries as well as in the southern, and here in the States they have a strong foothold, all the way from New England to the rich pastures of the Far West. They have been successful in adding immensely to the wealth of the States. This breed has so thoroughly established itself in the States that it seems almost a waste of time to present its claims for the consideration of farmers in the West. There may be those who have not adopted the use of this breed, because they do not believe in discarding or improving their scrubs, which were good enough for their forefathers and just as good for them.

I will endeavor to show wherein this breed of Short-horns, with its grades, is the best for the general farmer of the Western States. Here let me say that I am not prejudiced against, or in favor of, any particular family. These divisions have been made by parties for their own special gratification, and these men have been building up this, that, and the other family, till many of them claim that their peculiar pet strains are the only true *and model* Short-horns. We are well aware that many of our best animals are in these selected strains, but we now wish to advocate the merits of the Short-horn, *as a class* and our motto is, and ever has been, to look upon those as the best that combine the most of those points which go to make up an animal of the greatest excellence, whether they belong to the descendants of a "Bates," a "Booth," or to those (despised by many) of the Kentucky importation of 1817.

First. The broad and deep chest, moderately thick and mellow skin, with an abundance of soft, fine hair, show them to be animals of undeniable constitution, which is the first essential point to be considered when selecting this or any other kind of live farm stock. Perhaps, as a class, no other race of cattle is superior or equal in this good quality, which is so necessary for robust, vigorous, and healthy growth.

Second. Early maturity is another eminently good quality in their favor. By liberal feeding the heifers make such sufficient growth that they can be bred to bring a calf at two years old, and the steers may be put into market at thirty months old, giving a carcass of fine, rich beef, not to be excelled by any other breed at this early age.

Third. Another characteristic is that when not pampered and held back for show purposes the cows are regular breeders, unless by continual "in-and-in" breeding, as in the Duchess tribe, such families may be more uncertain.

Fourth. The milking properties are very prominent. In their native country they have stood at the head for generations, and still hold the position in most, if not in all, the large city dairies. They give an abundant supply at every milking, and continue it for nine or ten months, or within a few weeks of calving. If they are superseded by the Alderney for yellow cream and butter, they are not for quantity nor for richness, when feeding on good, luxuriant herbage. The butter made from the milk of the Short-horn cows cannot be surpassed in excellence when on equal feed. There have been many instances of large amounts of butter per day; in many trials there have been individual cows that would produce over two pounds per day, and this is not uncommon; but few cows of any breed have yielded so large amount of butter during the year.

We often hear the term used, "milking Short-horns." In their early days the

whole race were looked upon as milkers, their fattening qualities being secondary. But when the early breeders became sufficiently interested in the improvement of the breed, and gave strict attention to the business of coupling the animals, so as to retain the milking qualities and increase their aptitude to fatten, then it was soon made clear that this was the most desirable of all breeds for both purposes. The aim of the early breeders being to produce a useful animal, an animal to meet the demand for beef, butter, and cheese, they required these qualities, rather than pedigree.

Fifth. The pure Short-horn is also best for beef. At an early age they will produce a very level carcass of fine, marbled beef, though some claim that this is not "No. 1" quality. Here let us look at the fact that there are but few, very few, pure Short-horn steers put into the market, the demand being so great for bulls, that it does not pay to castrate and turn them into beef. Take the London market, for instance. The quotations there are, and have been for many years, the highest for "Scots," Short-horns being quoted lower Many of us know that the quotation takes in *all grades* of this breed, and the number of bullocks of this class, from the *lowest grade* up, is simply legion, when, on the other hand, the Scotch cattle are represented by many of the best calves made into steers, and spayed heifers. Herefords, likewise, in that market, are represented by the very best, there not being the demand for bull calves.

During the short period of excitement over the fashionable pedigrees and exorbitant prices which made so many crazy, the general farmer looked shy at the breed. If he had anticipated making purchases, he became disheartened, and by the continual clamor through the press of this and that family realizing those high prices, he concluded that others were inferior, and, not being able to purchase the fashionable ones, would not invest in the general run of useful Short-horns. The days of high prices soon run their course, so that now prices have become quite reasonable, and the general farmers of the West see clearly that a pedigree without individual excellence is worthless.

Sixth. No other breed will cross so well on all kinds of common cows. The Short-horn bull leaves his stamp to a great degree every time, so that the first cross is often equal to the second in other breeds. I do not wish to be understood that the stamp of color merely is given, but, in a great measure, the shape and general characteristics of the breed. Most breeds will give the color, and yet lack in making the desired improvements. The Hereford is almost sure to give the "white face," but does not make a good cross. By using none but thoroughbred bulls on the common or grade cows, a class of animals are raised that are suitable and remunerative alike, in a good degree, for the farmers of the Western States. The cows of high grades are nearly equal, and, in many cases, for milk quite so, to the pure blood. They are abundant milkers and easy feeders, and if not quite so fine in quality when fatted, will give a serviceable carcass of beef. The steers and surplus heifers from these cows are readily fatted at an early age, and the beef will realize more than the average price.

We cannot put these grades on a footing with pure Short-horns, but we will venture to say that, as a part, they are, under the circumstances, the kind for the general farmer, for the reason that all are not able to procure the thoroughbreds. It is a great mistake, and to be lamented, that the grade bulls should be bred to cows having one or more crosses. It is more profitable to purchase a thoroughbred calf, which can be had for the price of a good fat steer. When we class these grades with pure Short-horns, let it be understood that they should be bred up nearer in every generation, thus making them a very desirable class of cattle, adapted for the rich pastures of the Western States, whether as cows for dairy purposes and raising calves to be grazed along for beef, or as steers capable of making a profitable carcass of rich beef at an early age.

It will be remembered by those who visited the "fat stock show" at Chicago last November that, while Herefords and their grades made a good showing, the Short-horns and their grades were represented by much larger numbers, and a large proportion superior to any other breed. The light grades exhibited from Illinois and Iowa were not only numerous, but almost every animal was made up into a carcass of the greatest excellence.

When we take into account that these fine cattle had not been pampered and were not fed in stalls, most of them having been fed in the field, it shows that the breed is capable of enduring the changeable climate of the West. These cattle had been generously fed, and the price realized for those sold was satisfactory to Messrs. Gillett and Munninger, the owners and feeders.

It has been claimed by some parties that the Short-horn bulls used in the large herds of Colorado and Wyoming did not meet the expectations of those using them. This may be correct, but why is it so? For the reason that unprincipled parties have sent out low grades, and passed them for Short-horns; and what can be expected of the steers? On my way to Colorado in 1881, I met a gentleman who owned a herd of several thousand head of cattle on the Powder River, in Wyoming Territory. He said he had been through Kentucky, Illinois, Iowa, and Ohio, and wanted to know why his steers did not show the Short-horn like the half-bloods of Ohio and other

States. My answer was, "You have not had pure bulls." This is in a great measure the reason why the owners of many large ranches have been induced to *try* the Hereford bulls, and hence the demand for bulls of that breed. Many white-faced animals of low grade are sent out to those ranches, and time will show that this breed does not make the desired improvement.

Many will agree with me that no cattle ever brought into the Western States combine so many desirable and strictly useful qualities as the Short-horns and their grades. One great error of many farmers is that they expect more of this breed than they have any right to hope for. To think that these cattle would thrive where many others would starve is unwise and unreasonable; such parties should not purchase them if they expect them to succeed when left to shift for themselves during the inclement weather, or to thrive and fatten on scanty pastures, with a short supply of winter food. No grazier or farmer has a right to expect any breed to be profitable when neglected and abused in this way, and certainly such men never ought to own a live farm animal.

Every animal should have an abundance of good, wholesome food, as they have a capacity to lay it away quite profitably to all who employ them as a means of turning the farm products either into a large quantity of rich milk, to be made into butter or cheese, or into a large carcass of rich beef, which, in either case, will realize the highest market price.

For the many good and useful qualities which have been named, and for their adaptability to the varying climate, I claim that the Short-horns and their grades are the best breed of cattle for the general farmer of the Western States.

The CHAIR. We will devote a short time to a discussion of this paper. (After a pause.) If there are none who wish to discuss the paper, the next paper will be by Colonel Beverly, of Virginia.

Colonel BEVERLY hoped there would be a discussion of the paper.

Mr. SANDERS, of Illinois. I would like to hear from the chairman (Mr. Coffin) on the question. You have had much experience in this matter, and your observation has been very extensive.

The CHAIR. There are other papers that may lead to some thoughts I wish to bring out, and I prefer to defer any remarks for the present. I do not feel capable of criticising the paper or making any remarks thereon.

General N. M. CURTIS, of New York. I should rather commend than criticise the views and position taken by the gentleman who has favored us with the last paper, and therefore it would be idle for me to discuss a matter in which I have such thorough sympathy. But I discover those in the audience who are accustomed to write articles and essays upon subjects of this character, who, I believe, entertain somewhat different views, and I think it would be exceedingly profitable to the Convention if one or more of these gentlemen should illustrate and indicate what their choice is, and their reasons for favoring some of these other breeds. In popular phrase, I am "catching high" in my friend Frank Curtis. I think it would be desirable to hear from him.

Mr. FRANK D. CURTIS, of New York. I have a good many old grudges against General Curtis for singling me out on other occasions, but now I am on the floor I will say, that I am one of those who believe a great many things, and at the same time do not believe a great many other things. I believe there is no one breed of cattle destined to fill all the requirements of this great country. Neither do I disbelieve that every breed has its merits and its special adaptation to certain purposes and localities. When I have said that, I have said enough to cover the whole paper and the whole ground; but I will add, however, that I am not a breeder of Short-horns. I stated a number of years ago that the Short-horns would run out in New York. I have found that our farmers have very little use for Short-horn bulls, for the reason, in my opinion (and the history of the Short-horns in the State of New York verifies that opinion), that they are adapted to special purposes and sections, and I agree with the gentleman from Ohio who read the paper, that they

can fill their purpose to the best advantage and in a most admirable manner, in the great meat and beef producing districts of the West. The pasturage of New York is not rank nor strong enough to maintain the Short-horn cattle. Our winters are severe, and with the methods of feeding which have been so common in our State, and considering the short-handed way of feeding stock during our long winters, these Short-horn cattle annually deteriorate, unless in the hands of gentlemen who appreciate them highly and depart from the common systems. Under these circumstances, they are decreasing. We originally boasted of the finest herds in America or even in the world. They are decreasing with us, and are marching to their natural home, the great West, for which section they are especially adapted for the purpose of improving the beef cattle. Now I admire every breed of cattle. I do not know whether it is because I have such a big heart, or because I am simple-minded, but I have a perfect admiration for all breeds of cattle. I love to look at them all and study their qualities, because in the providence of God they have been reared, each one of them, for some special purpose for which they are peculiarly adapted. Hence, while we admire and love our own and praise our own and breed our own, we must not forget that others are equally meritorious in their places. [Applause.]

Mr. BAKER, of Ohio. I wish it understood that my paper was intended to apply to the use of the general farmer of the Western States.

General N. M. CURTIS, of New York. If the farmers of New York adhere to the suggestions made by the gentleman from Ohio, there would be greater advantage to them, in the long run, in using Short-horns for sires than in using the animals they now have.

General Curtis then gave a sketch of the introduction of cattle into the East, and in referring to the contagious diseases spoke as follows:

If this contagious disease were removed absolutely from the East—from the Northeast, where we have so many of our dairies, the Western people would cease to fear its introduction by receiving our dairy calves into their country, and we might, by the general introduction of Short-horn bulls into our dairy herds, furnish the West with calves reasonably. It would be a great advantage to us in the East to send out our dairy calves to be fattened on the richer lands and cheaper pastures of the West—much greater than to have them slaughtered when a few months or a few days old and their carcasses sent to the Bologna sausage makers. But we are deprived of that advantage, and it must necessarily be so to a great extent until the country shall awaken to an appreciation of this condition under which we are now suffering and take measures to have this disease along our eastern frontier stamped out, so that we may feel free in transporting our cattle either way, as it may suit best the markets for supply and demand. And that point is of more importance to you in the West than has generally been supposed. It is really the Western States, and such of the Southern States as are among the beef-producing sections of the country, that are losing most heavily from the prevalence of this disease in the East, where there are comparatively few cattle, and none for export. Yet England schedules this whole country, and every bullock which goes from the American ports must be slaughtered on the dock in England, and cannot take advantage of the markets in the inland towns.

We are losing in the last two years a sum equivalent to about two million dollars a year. That money goes out more directly from the Western farmers and feeders and breeders than from anybody else. The disease itself is not there; still it is made a sufficient reason, when England remembers the suffering she has endured, to schedule against

us. Canada is not so scheduled against, as to the shipment of cattle to the English markets. I have taken some interest in this, and find that a Canadian bullock brings from ten to fifteen dollars more than an American.

A DELEGATE. You might say ten to twenty-five.

General CURTIS. Now, remove by such action as is essential this disease which is located in but a small section of the country, and you will enjoy the privilege of sending your cattle to England without this restriction.

But I have wandered off from what I started to say. I do believe that the section of country that the gentleman from Ohio has indicated would be benefited by the introduction of this breed of cattle. I believe, too, that the provision which might be made by the wise action of Congress, would enable a large territory of the country to derive an additional advantage in their dairy system by having calves that could be sent to the West to grow up with their herds; and being for the most part three-quarters bred animals from such sources as the Short-horns, it would be an object of real interest to the farmer and to a farming community.

Mr. COFFIN, of Iowa. I did not think when my friend Mr. Sanders called on me that I would say anything just now, but some thoughts, suggested to my mind by General Curtis' remarks, have led me to do so.

I look upon our position in this Convention as quite an important one. The Convention is called by the Commissioner of Agriculture, and most if not all of the gentlemen who attend it came not with selfish ends but with an eye to the general good of the country, and the general good of agricultural interests. It is very important, therefore, that we wisely consider every step we take. If a paper be read here advocating a particular branch of husbandry, a particular grass, a particular grain, or a particular breed of cattle, and it receives the approbation, perhaps the silent approbation only, of the Convention, it goes out to the nation that this Convention of representative agriculturists from the whole country is of opinion that a particular breed, a particular grass or grain, as the case may be, is best for the whole people. Therefore, we should act with a great deal of consideration. Now, I am heartily in sympathy with the paper read, and some remarks made by our friend Mr. Curtis, of New York, induces me to say a word right at this point. Speaking of the hard winters, long winters, the food and the general way of feeding in New York, he stated that the Short-horn cattle ran down and came out generally poor in the spring. I want to defend the Short-horn from that cut. I do not sympathize with that. I do not believe really, and my friend will pardon me, that it is necessarily true. You in New York feed some remarkably fine herds; and we Western folks think they are too finely bred. We think perhaps you have committed the error with some of those noted breeders in New York, of continuing too closely in line of inbreeding, and that these gentlemen handled their herds in such a way that they necessarily made them tender. They are not a hardy race. The breeding animals from some of these herds have been scattered over the State, and produced a class of grades and full bloods that are not of the hardiest and most robust class, even of Short-horns.

In our experience in the West, we are breeding a fine breed and handle families of the Short-horn that we find just as hardy as our native cattle. They will live through winter with as little corn, and come out in as good or better condition than our natives, or our "scrubs," as we call them. I have to-day on my own farm a cow that I think is 12 or 13

years old. Last winter she went through the season, and kept in grand flesh, without a kernel of corn, but was fed on hay, corn-stalks and straw. Now it is not the fault of the Short-horn breed, as a breed, that we find it necessary to temper and feed them on gingerbread and doughnuts, and all that. It is the fault of the men who have been breeding certain families of the Short-horn. That is my humble opinion.

Take the grand animals that Mr. Gillett brings to our fat stock shows, or come to his farm and get from among his herds cows that were never under a cover, and hardly ever saw an ear of corn, and you will find them in fine condition. We fight for the Short-horn and fight for him with a reasonable and proper kind of training and feeding and breeding.

I am frank to say, I fully believe this Convention would do the country a good service to let its utterances be that the Short-horn is the breed of cattle for these United States.

A DELEGATE. For beef?

Mr. COFFIN. For beef or for milk. I do not think there is any better for beef or for milk than the Short-horn. It is my honest opinion, we can take certain families of the Short-horn and develop the milk, and they will be second to no other breed of cattle for milk, no, not excepting the Jerseys. But when we have that quality in that breed, combining the beef and the milk as no other breed under the sun does combine, then I am frank to say I am with this Convention to show the general farmer that the Short-horn is the best breed for all practical purposes.

Professor KNAPP. I have lived among a very large number of enthusiastic Short-horn men, and it has been by a sort of courtesy that they have permitted me to say a good word for anything else.

In order to substitute the exact facts for the enthusiasm of my friends, I placed, three years ago, fourteen Short-horns on one side of the barn, on the other side six Devons, five imported Holsteins, and two common cows. I treated them precisely alike. In the summer they were with the herd and fed the same amount of grain. I did not feed them the same amount of grass or hay. These things are cheap in our country, and I allowed them to help themselves. It is true that the Short-horns maintained better flesh; they maintained flesh more equally than the Devons, and they did not require so much grain as the common cow to be kept in the same condition of flesh, nor so much as the Holstein. But when my friend says they will give as much milk and as good milk as some of the other cows——

Mr. COFFIN. Will the professor allow me to correct him?

Professor KNAPP. I have not made my statement, but I will take the correction first. [Laughter.]

Mr. F. D. CURTIS. I think the Professor probably misunderstood me. I will say that we can select families of the Short-horn and develop the milk quality that will be second to no other breed. I do not say the whole breed, but we can select families.

A DELEGATE. Have you done it?

Mr. F. D. CURTIS. I think I have.

Professor KNAPP. We selected a cow and carefully analyzed the milk. We made one hundred analyses of the milk during the summer. The Short-horn milk had a good deal of fat. In one cow, I remember, it averaged $\frac{25}{100}$ of fat. The Holsteins went from 3, varying in the different cows, from 3 to $3\frac{25}{100}$, and when you come to the amount of milk, the little Holstein heifers gave over 8,000 pounds during the summer, and the Short-horns about 4,000. That is the fact of the case.

I am willing to admire the Short-horn. It is the finest combined cow,

and I never saw a finer on the farm that would answer all the purposes of the breeder.

Dr. ELLZEY. I would like to have a few words. When my friend said that families of Short-horns could be selected which would be equal to any other breeds for milk or beef, or for both combined, I agree with him heartily, and I agree with him not without experience upon the point generally and not without investigation which extends over a good many years. I am familiar with the Jerseys and have handled them to some extent. I am familiar with the Devon and with the native cattle of the country, and in fact with almost every known species of cattle, except these Polled-Angus cattle of recent introduction, of which I have only seen a few individuals. It is therefore not without knowledge, that I now speak on this subject. Acting upon the theory that my friend has expressed, when I was called upon to select a herd of Short-horn cattle for the Virginia Agricultural College, I selected individuals with the view of producing both milk and beef. One of these cows has uniformly taken the premium for the best butter cow at the State fair at Richmond, and she has a milk record. We do not measure it by pounds, but by gallons. She has given eight gallons per day a year. She keeps in fine flesh, and when she goes into the show ring she wins premiums almost invariably. She raises calves that are among the very finest specimens of beef, and the heifers that have been produced from this selection carry with them the same qualities as the original cow. What my friend there states about this herd is the truth, and nothing but the truth. He says in his official report to the legislature, "our herd is becoming noted throughout the State, not only for the ordinary characteristics of Short-horns, but for their milking qualities, which add no little to their value. We sold all the bull calves we had on the fair ground at fine prices, every one of them, and could have sold as many more to the leading breeders of the State."

There are plenty of fine herds of Short-horns in Virginia to compete with this herd. There is a herd of cattle which does combine (and I know it, for I have seen them in the show ring, and in the pasture) in the very highest degree beef properties and milk-making qualities at the same time. One of these cows in good flesh, and it was hard to keep her down, weighed 2,000 pounds, and she was as smooth and fine a specimen of the Short-horn cow as I have ever seen. I have seen a very large number of specimens, including those in the State fair at Richmond, from Virginia and other States, because I had personal charge of the show ring for a number of years, and since I ceased to be a member of the organization I had acted there as sole judge and was forced to make critical examinations. I say that the herd of cattle at this college does combine, and it can be demonstrated and proved at any time, in the highest degree of excellence, beef and milk producing qualities.

Now an analysis of the milk, to which my friend refers, is a very deceptive thing. If you set down that the analysis which shows the most fat or the most caseine, or the most something else, as the case may be, the most mineral salt, for example, as the best, why you are apt to be very far wrong. It is the proper combination of all the elements found in milk which you are aiming at, and this is the deficiency in the Jersey breed. I am the owner of Jerseys, and I say that the milk of these animals after the cream is removed is unfit for family use. I state this as a practicing physician of many years' experience. I know the fact that it does make children sick, and is not fit for family use.

Mr. F. D. CURTIS. After the cream is removed?

Dr. ELLZEY. Yes, sir. It is unsuitable, and I will not consent that children shall have the milk of the Jersey either as a whole or in part. The Jersey cow is essentially, in a pre-eminent sense, a butter cow and nothing else, and I am an owner of the breed and interested in them. I am likewise the owner of Short-horns.

Mr. F. D. CURTIS. I should like to ask the gentleman why he thinks that the Jersey milk makes children sick?

Dr. ELLZEY. I referred to infants that are taken from the breast and fed this milk, not the children who have to drink it at the table. It is a matter of experience with me in my own family.

Mr. F. D. CURTIS. I have had experience with Jersey milk also. I am a breeder of Jerseys, but my experience differs somewhat from the gentleman's. Now, I can conceive that the Jersey milk, after the cream has risen, would be unfit for young infants as food, because there is not enough nourishment in it. But that it is unfit for children beyond infancy I have not found it to be so, because my children drink a great deal of it. I do not think it does them any harm, nor do I think it does them very much good.

Dr. ELLZEY. If the gentleman will allow me one word more. I have found, and I think I was the first to publish it in the papers, for which I was pitched into most vociferously by every Jersey breeder, that the milk of the Jersey cattle is not suited for young infants. Furthermore, I have in several instances known Jersey calves that became so sick with diarrhœa that we had to take them from their mothers and feed them artificially. The milk was so rich that they could not feed their own calves.

Professor KNAPP. The question I wish to ask is simply to get at the fact, and if it be so, I wish to recognize it as a fact. You say that this Short-horn herd was a first-class herd for milk; what is the record of the entire herd?

Dr. ELLZEY. I do not know; perhaps Mr. Conrad can give it now.

Professor KNAPP. There is a difficulty in recognizing the merits of a special cow. For instance, we have a "scrub" that I think would lead all the Short-horns by the amount of milk.

Mr. SANDERS. I do not like to interject an amendment into an amendment, but I would like to have the Professor tell the convention, as he told me, that she had all the records of a Short horn, and he thought she was a Short-horn.

Professor KNAPP. That shows you how fertile is the record of the Chicago men. [Laughter.]

Dr. ELLZEY. Well, my statement will be short. I have said that the pure-bred Short-horn has the merit of the combined cow, but it is a mistake for gentlemen to suppose that you can have an animal that combines these different characteristics at the same time. Now, I say this, sir, as a physiologist who has made it a special study for a long time, and as a physician who has made a special study of it for agricultural purposes, and as a farmer and teacher of agricultural science who has made a special study of it with reference to animals. Now, it is true a cow will not be generally in high flesh when she is giving a vast amount of milk, but the cows which give the very greatest amount of milk when you dry them up very frequently fat with astonishing rapidity. Now, is not that combining beef and milk?

This, perhaps, would not be doing the same things at the same time. I could not haul saw-logs with my horse and drive him to the chaise at the same time, but I could haul saw-logs to-day and put him to the chaise to-morrow. You can have a breed of Short-horns which will com-

bine these merits. If I have a horse that is the proper medium—for instance, a horse 15½ hands high—he is good to plow corn, to ride of a Sunday, and to drive to my one-horse chaise. I own one of that sort, and I can prove that to anybody who will ride behind him. Now that combination is one upon which I think almost universally erroneous opinions prevail among scientific men, and it has grown out of the somewhat rambling expressions of Mr. Ewing, who has made more of the combination than physiology warrants. I would not say it, unless I had looked into the matter for a long time in diverse directions, and unless I had a number of years' experience and acted upon that, contrary to the advice, the clamor and directions volunteered by and solicited of divers persons. I proceeded upon that idea in laying the foundation of this herd against everybody's judgment, and now the result is, it is one of the most popular herds in the State of Virginia. The sales from it probably exceed those of any herd of the same size in the State, because it has a reputation of a combination that produces both milk and beef. I have examined hundreds and hundreds of cows in the last twenty years continuously, and I have found them to be the best dairy cows, take them as a class, and far the best dairy cows for all purposes I have ever examined for making butter, even, with the exception of the Jersey, which I admit to be a specialty for butter. I have examined the Holsteins in large numbers, and I say the best class of cows is the Short-horn.

Professor KNAPP, of Iowa. I wish to correct a misapprehension of the other side. I certainly do not intend to say that we have found there can be no good combined animal, for I believe you can have an excellent combined animal. The point to which we take exception, is that you can't have the highest excellence for particular things and for all other things in the Short-horn. You can have the best breeds of animals in the world, best butter and cheese and all, and this combined animal is the best for specific requirements. I should take the same exception in the matter of horses, not that we cannot have a good combined horse, but cannot have the best trotter and running horse. I am in favor of a good combined animal.

The CHAIR. Gentlemen must bear in mind that we have another paper.

Mr. HADWEN, of Massachusetts. I merely wish to touch upon one point referred to by the gentleman on my right (General N. M. Curtis, of New York), in his remarks upon pleuro-pneumonia in the East. It did exist in Massachusetts twenty years ago, but it was stamped out through the exertions of the legislature and the board of agriculture. Since that time a regular cattle commission is appointed by the executive, and it has the power to stamp out, at the expense of the State, either pleuro-pneumonia or any other cattle disease. I wish to refer to one other point, the Jersey milk. I fear the impression has been made that Jersey milk is unhealthful food for infants or adults. Does anybody know of a better race of people on earth than that of the islands of Jersey? They have had Jersey milk for generations, and are as well developed a race of people as exist. I know from personal experience that this charge is untrue, having sold Jersey milk for more than fifty years to families that have reared children, and well developed children as I have ever seen. I do not propose, for want of time, to touch upon the specialities of the different breeds of cattle, but I do believe that all the animals which have been spoken of here to-day are good for some husbandry. For the dairy section of the country, I believe that the Ayrshire and Jersey are *par excellence*. I know this from prac-

tical experience, for I have kept not only the Short-horns, but the Devon and Ayrshires and Jerseys of pure breeds. I should like to continue and enlarge upon my reasons, but I will not trespass further upon your time.

The CHAIR. The next paper in order now is one by Col. Robert Beverly, of Virginia, upon "Breeding and Feeding Beef, and the Supply of the Market therewith."

Colonel BEVERLY then presented the following paper:

BREEDING AND FEEDING OF BEEF, AND THE SUPPLY OF THE MARKET THEREWITH.

By ROBERT BEVERLY, *of Virginia.*

Having been requested by the United States Agricultural Society to say something to this Convention on the 7th topic of discussion, I approach it with conscious inability to do it justice, first, because I am not a breeder of cattle, and secondly, though I am a large feeder, the climatic influences and circumstances, as to soil, proximity to market, extent of territory, price of land, &c., are such important factors in this industry or occupation, that I am aware it is almost impossible to treat the subject successfully before an audience coming from so many sections of the Union.

Having never been a breeder of cattle, I will ignore the much mooted questions of inbreeding, cross-breeding, &c., hoping, however, to hear them discussed here, and will merely state what breeds my experience teaches are best suited to different industries in varying climates.

Where *milk* is the object either to cities, or cheese factories, or even to the family, the Ayrshire is preferred. Where *butter* is the object the Jersey is the breed, because the butter separates from the milk more perfectly than in any other breed, leaving the milk nearly colored water. I would remark just here that there are *families* of cattle in all classes or breeds, that are particularly adapted to the dairy, yet they predominate more generally in the two breeds above mentioned. For beef and the shambles, there is no breed, in my opinion, equal to the Short-horn for early maturity, excess of weight and fineness of texture in the meat, coupled with juicy fatness, and that breed and its grades, suit the beef-grower best in all climes and conditions where *plenty* prevails, either of grain or grass. Next to the Short-horn is the Hereford, the beef of which is as fine as the Short-horn, not so large at the same age, but fattens more kindly on a little less keep. Then, for *general utility*, where short grass comes in, there is no breed in my opinion equal to the Devon. Some families of them make fine milkers; all of the geldings make fine beef, and attain more size on short grass and hard keep than any breed I am familiar with. And for oxen no breed compares with them, being fully large enough, and covered with a heavy coat of hair and longer and stronger hoofs, as indicated by the length of horn; they never get foot-sore.

As to feeding and fattening cattle, this is a very wide and varying subject and would take a long time to treat it in all its branches. The most economical feeding to make the most of any animal for the shambles, is never to let him get hungry so as to lose a pound, from his birth to his sale, not to lose in the winter, or even a week or a month of it, any of the weight you have been putting on the previous summer. Grass is the cheapest food that fattens cattle, and when in abundance and of good quality, makes weight, if not fat, faster than any other food. Therefore, leaving out of view the time or age at which you propose to market the animal, the most economical plan to grow him up and to fatten him is, to feed sufficiently on grain, from the 1st of November to the 15th of April, or to grass, to keep every pound on him he had, and probably to increase his weight a pound a day to grass, and then rely on grass for your principal increase.

Thus, on an animal of any of the beef breeds you can put an average of one and a half pounds a day from its birth, and when three and one-quarter years old make it weigh 1,600 pounds at least, at about this cost for grain: First winter, a calf, feed a pint of whole corn a day, or 150 pints, or say 2½ bushels, the winter; cost, at 50 cents a bushels, $1.25. The next winter, when yearlings, feed one-half gallon corn per day, making, say, 10 bushels through the winter, at a cost of $5 for grain. The third winter feed a gallon a day, or about 18 bushels corn, costing $9, aggregating $16.25 for grain, and sell the 15th of October, when the animal will be about three and a third years old, and ought to weigh 1,600 pounds, relying mostly on the grass as being the cheaper food to put on the weight. The grass costing for the calf up to the first winter not over $1: for the second summer, when a yearling, 75 cents per month, or $5.25; for the next year, or when a two-year-old, $1.25 per month, or $[illegible].25 for the third year

up to October, after he is three years old, $1.50 per month, or 6 months, making $9, aggregating $23.50 for grass and $16.25 for grain, and say $15 during the three winters for roughness, which is a full estimate without going into detail, thus making the animal cost $55 to sale at three and one-third years old, when such an animal ought to sell for 6 cents, gross, in the market, or $96. Supposing the calf to be worth $10 when you start with him at the beginning of the first winter, take off the $1 charged for grass the previous summer, and you have the whole cost, $64, and the sale $96, being a profit of $32 a head on the operation for three years to pay for your attention and the three years' interest on $9, the first cost of the calf, or, say $10 a year on the animal: and who would handle him for less?

If you design to put your animal into market the spring that he is three years old so as to take advantage of the higher market, you must feed a peck of grain per day the last winter, instead of a gallon, and it will add $9 to the cost of wintering, but save the grass of the following summer, for which $9 is charged; then if the price is $7 per hundred in April or May, you sell your animal at $1 per hundred more than estimated for October. But even with the additional winter grain he is 200 pounds short in weight, yet he sells for $7 at 1,400 pounds weight, or $98, against $96 in October off grass, and you save the interest on the money and the risk of the animal's life for five months.

The system as adopted in Virginia, with which I am best acquainted, is to buy the cattle in November, at two and a half to three years old, brought from Tennessee, North Carolina, and the mountainous counties of Southwest Virginia and West Virginia, the nurseries of young or store cattle, and feed them through the winter from 15 to 40 bushels of corn, according to size and quality, and to market them from June to November of the following year as they become fat off grass, on which we usually turn the 15th of April, relying on grass principally for weight. From accurate experiments I find it is easier to put on 3 pounds per day with good and abundant grass than 2 pounds per day with all the grain they will eat, the grass costing 5 cents per day and the grain 12½.

As to the manner of feeding. In this I do not expect concurrent opinion from this assemblage of farmers and feeders, but, coming as I do from the temperate climate of Virginia, and where the farms are large, varying from 400 to 1,000 acres, I am decidedly of the opinion that feeding out of doors is the most economical and profitable, all things considered; and if I had not a barn for feeding cattle I would not build one. After four years' experience in feeding 200 cattle on my home farm of 1,000 acres, 52 cattle in the barn and 150 out, I have come to this conclusion, because feeding the same quantity of grain to the barn and the out-cattle, and both having all the roughness they would eat, and they being all bought together, and the same cattle to start the winter with, I have found that the proportion of the barn cattle to get fat latest was greater than the out-cattle. Then the labor of hauling all the forage from the distant part of a 1,000-acre farm to the barn and the manure back to those distant parts, is enormous. I can well understand that on small farms, from 100 to 200 acres, there may be an advantage, especially in a more rigorous climate than Virginia, but there the lee side of a hill, or a stone fence, or a margin of wood is all that the animal seems to want, and that only in very windy weather.

My mode of feeding in the barn is in stalls, made by swinging gates, the cattle put in at night and fed both night and morning, and let out soon after sunrise in a large lot, with water and racks of straw or corn-stalks for them to pick during the day. My mode of feeding out is to haul out the corn and fodder, all as it grows, in the morning as soon after sunrise as possible, and then a large load of wheat straw; scatter both broadcast over the field on the poorest parts, usually a sod field, and no more that day, but giving them as much at that feed as the barn cattle have through the twenty-four hours.

As I said before, the out-cattle go into market about as early as the barn cattle, many think with more weight, but not having tested that accurately, I do not say; but the manure is scattered nearly where you want it and with far less labor, which is money. Then I believe the hoof on most soils in the winter, to stiffen it, is advantageous, otherwise your land gets too light and *puffy* and brown-sedge comes in, and I know of no remedy for that, save the hoof or the plow.

As to kind or quality of feed in winter—we all believe in grass in the summer—I am sure I shall antagonize many opinions on this subject; yet I am asked for my experience and I shall give it. It is, that *whole corn* fattens the animal, a steer or heifer with good teeth, faster than meal. From actual and frequent experiment we have found that *whole corn* will put on 20 to 30 pounds more weight per month than the same quantity of corn-meal, and that in feeding whole corn, a hog to every 2 steers will fatten well after them, where in feeding meal they will barely hold their own. I am not an expert or sufficiently acquainted with the anatomy of the ox to give intelligent reasons for my observation, but believe that the nearer you treat an animal as nature has designed him, the faster he improves, and nature designed the ox to live on rough, coarse food, to swallow its food into the first stomach, and then

brought back and ruminated, whence it passes, as nature designed it, through the several stomachs and is assimilated in its passage. Whereas the corn-meal passes at first into the third or fourth stomach and passes off undigested and sometimes in clots, not discolored. I am asked, then, why does the hog, following the cattle, starve after meal feeding? I answer, because the meal, though undigested, is so mixed with the dung proper that it sickens the hog and he will not eat the mass to obtain the good; whereas in feeding corn the half digested grain, or half or quarter grain, can be picked out and utilized by the hog, and nothing is lost to the feeder.

Did time permit I could give many experiments to prove this theory, but possibly many of my hearers may be equally familiar with the facts, and it is a waste of time. I, therefore, conclude that Indian corn, unground, is, for the price of it, the cheapest and best feed to fatten cattle on, unless it be cotton-seed meal to those who feed in barns, as it has to be fed in troughs. I have tried linseed-meal, bran, or wheat offal and cotton-seed meal, the latter but one winter, and I know that corn is better than linseed or wheat offal; but believe cotton-seed meal, at $25 a ton equal to or better than corn at 50 cents a bushel. As to ensilage, I have not much experince, but what I have brings one to the conclusion that for breeding ewes and milk-cows ensilage is far superior to dry food; but for fattening cattle the same corn-fodder cured dry is equally valuable. The only value I can find in ensilage is that you can preserve in a small pit in the ground, and preserve its watery parts, the same bulk that would require very large barn room to preserve it dry.

As to marketing beef cattle, I am clearly of the opinion that beef cattle within 100 miles of the market should be *driven* to it, for the reason that they lose less pounds in that drive, say five days, are not bruised up by crowding in cars, and do not become so feverish before they are killed, thus destroying the flavor of the beef. The nearer the pasture or feeding barn the animal is slaughtered, the better the beef, and an animal of the same quality slaughtered at *home* is intrinsically worth 2 cents a pound and more than those carried 1,000 miles. Having perfectly tested this matter I know I am correct in this opinion. As to refrigerator beef brought from Chicago or any other distant market here, it is far inferior to our home beef. In the first place, *best* grades of cattle are quoted in the Chicago market at 6½ cents per hundred, gross, as high or higher than our best grades sell here, and being perfectly familiar with the Chicago beef market, I know we have them fatted in Virginia, Maryland, and Pennsylvania as good as even go to Chicago. Then, how can they slaughter the *highest grade* of cattle there, where the fifth quarter is worth less than here, and bring the net beef here at a cost of $180 a car or $6 per animal, and sell it for less than our butchers do here. They can only do it by buying the refuse animals, coarse steers, or stags, or cows, or diseased animals, and sell them here for first-class beef; and until it is tested on the table, it is difficult (such are the arts of the butcher) to tell anything about it. I can only say I would rather give 2 cents a pound more for beef slaughtered at or near the home of the animal than for that transported 1,000 miles.

As to the export trade, American beef, acknowledged by Englishmen and by the late English minister, Sir Edward Thornton, to be equal to English beef, yet, transported to England, becomes so bruised and feverish that it sells for a penny or 2 cents a pound less in that market generally, but if they have a smooth passage, only a half penny or a cent a pound less. I believe the time is near at hand when ships will be constructed to take cattle to Liverpool as comfortably as they now take cabin passengers. Why not? The shipper having to feed and care for the cattle, $15 a head would pay them as well as a cabin passenger to whom they have to furnish luxuriously equipped state-rooms, saloon and dining-room accommodations, and the best of fare. The animal is furnished *space*, 3 by 9 feet, generally on the spar deck, or, if between decks, miserably ventilated, to suffocate with down hatches in a long storm, and condensed sea-water to drink, at $15 to $20 freight, the shipper furnishing everything else; and, when landed, met by those terrible restrictions—*to be killed at the port of entry within* 10 *days*. The butcher knows that, and he holds off to the last minute for compulsory low prices.

Mr. F. D. CURTIS, of New York. I have been very much interested in Colonel Beverly's paper, especially in that portion relating to the feeding of beef-cattle. I think it is one of the most absorbing questions—it ought to be at least—before the country. I am glad to know the speaker's experience, and that the country is to have the benefit of his very interesting and profitable paper. He spoke of cotton-seed meal, and finding that next best to Indian-corn meal, I would like to ask how he feeds the cotton seed meal and how he obtains his best results?

Colonel BEVERLY. My experience is very limited, having fed it last winter for the first time. I said that Indian corn—unground Indian

corn—was far superior to anything I have ever fed, except probably cotton-seed meal, with which I have made but one year's experiment. I have tried it in comparison with linseed meal and with wheat, and mixtures of all, and I think the whole corn is better than the linseed or wheat offal. My experience last year with cotton-seed meal led me to think it superior to corn meal. I am basing my calculations on cotton-seed meal at $25 per ton and meal at 25 cents per bushel. I fed in this way: I put the cotton-seed meal in the troughs every night on a large pile of wheat or cut-up corn-fodder. I found when I first put it in that the animals would not touch it. They got to eating it, however, through contact with the corn, and after a while they would eat it. I increased the proportion from one-half gallon to a gallon, and afterwards to a peck, and I never had cattle to fatten so rapidly in my life. It will not do to feed too much of a ration of cotton-seed meal at first, however. You must let the animal accustom himself to it.

Mr. F. D. CURTIS, of New York. I think the experience of such men as Colonel Beverly will bear me out in the statement that fully one-third of all the corn fed is wasted and a dead loss except so far as it may be picked up by pigs. The economy of feeding beef is one of the most interesting questions of the times, and when Colonel Beverly alluded to the fact of its being preferable to feed corn in the ear, he gave the proper explanation that when so fed the cattle digested more than when fed the meal, although when they eat it in the ear at least one-third is wasted, so far as the cattle are concerned, and the farmer would do well to consider this point. I believe if the Western farmer would take the trouble to cut up his corn-stalks in the form of stover and mix his meal with that, he would——

A DELEGATE. What do you mean by "stover"?

Mr. CURTIS. It means coarse fodder. I will use the term "coarse fodder." If he would cut that up and mix with his meal and feed to the cattle in that way, the meal would be retained in the first stomach and go through, in connection with this coarse fodder, all the processes of digestion. This would obviate the difficulty suggested and explained by Colonel Beverly, of the meal passing into the second, third, and fourth stomachs and being voided by the animal without assimilation.

Colonel BEVERLY. How would you do that with the thermometer down to within 30 degrees of zero and 1,300 cattle to feed? How would you mix it?

Mr. CURTIS. I meant that the most economical, the most saving, the most perfect way, would be to wet the coarse fodder and mix with meal. Of course you see the general advantage of these things. If the corn-fodder could not be wet under certain circumstances, why of course it would not work; but if you can ever convince the Western cattle-grower sufficiently for him to take the trouble to cut his corn fodder and mix his meal in that way, he must succeed in saving one-third of his corn.

General N. M. CURTIS, of New York. Without taking any part in the discussion, I would like to state a circumstance that came to my personal knowledge, and which covers this ground to a certain extent: There is living near Springfield, Ill., a native of Saint Lawrence County, New York. That is the form on which he fattens a large number of steers. He built a barn, put in an engine and grinding apparatus, and tried this system one or two years. With all these facilities on hand, and having tested it, he fell back on the old system of drawing his corn from the field into the yard and feeding his cattle. He abandoned it. Why, I do not know.

Mr. SANDERS, of Illinois. Mr. Daley, who lives in the same county

with General Curtis' friend, and who is perhaps the best feeder of cattle in the West—in Illinois certainly—says he thinks it much cheaper to make his steers do their own grinding. He finds it cheaper to get in this way the necessary additional warmth than to build barns. His plan is to feed whole corn, as Colonel Beverly has, and keep his cattle outdoors. He believes when a man is doing business on a small scale, he may make money by keeping cattle warm in the winter by good comfortable barns, and possibly they may do well at some other kind of feeding; but carried on as he does it, he believes he can make more money by letting his cattle do their own grinding. He hauls his corn out and scatters it around in a lot, and lets the hogs pick out the waste corn. I believe he makes as much money as any man I know of.

Dr. ELLZEY. A single thought occurs to me: that we have been in the habit of treating this matter of digestion and feeding too much as a chemical question. If you feed an ox that has been accustomed to the halter and is perfectly gentle and quiet under confinement in a stall, he will do better than out of doors; but put a wild animal that resents confinement in the stall, and he will not thrive however much you feed him.

The chairman announced the paper by Professor Law upon "Cattle Traffic in its Relation to Cattle Plague" to be the first in order at the afternoon session.

Professor KNAPP, of Iowa. Could we have a moment to introduce a resolution, made at the request of Dr. Abbott, who was unable to remain? At his request, I introduce the following resolution. It is not strictly germain to the present Convention, but it was impossible to prepare it before:

Resolved, That we indorse the bill introduced in Congress by the Hon. C. C. Carpenter, of Iowa, for the establishment of agricultural experiment stations in connection with the agricultural colleges of the several States, and we believe its early passage would greatly promote the interests of agriculture.

Professor KNAPP. I move the adoption of the resolution in order to bring it before the meeting, and I would further move, at the request of some gentlemen who have been in conference on the subject, that a committee of five be appointed by the chair to prepare a statement, perhaps I will call it an estimate, in regard to the value and importance of this resolution to present to the Committee on Agriculture, and also to have this work in charge.

General N. M. CURTIS, of New York. Do you expect this Congress to take action?

Professor KNAPP, of Iowa. I do not suppose that at this short session of Congress it will be possible, but we would like to have a favorable report by the Committee on Agriculture. They now have it under advisement.

A DELEGATE. I would like to ask if the appropriation is made directly from the Treasury, or is there to be an appropriation of public lands?

Professor KNAPP, of Iowa. It proposes to make it directly.

The DELEGATE. If we are to vote in approbation of the bill, in the ignorance of that bill, I think that——

The PRESIDENT. There is no question about the bill. The question is upon the resolution and motion to appoint a committee of five to consider the bill and all matters with it, and to prepare a paper to lay before this Congress.

The resolution and motion were adopted.

The president appointed as the committee Professor Knapp, of Iowa, Professor T. C. Abbott, of Michigan, Professor S. D. Lee, Paul Chadbourne, and President E. E. White, of La Fayette, Ind.

Then, at 1 o'clock and 5 minutes p. m., the Convention adjourned until 2 p. m.

AFTERNOON SESSION.

The afternoon session convened at 2.15 p. m., Commissioner Loring in the chair, and Professor Law, of Cornell University, was introduced and presented the following essay:

CATTLE TRAFFIC IN RELATION TO CATTLE PLAGUE.

By Professor Law, *of Cornell University.*

Mr. Chairman and Gentlemen: Wherever a genuine cattle plague exists, the area of its prevalence is mainly extended through the medium of cattle traffic. All plagues possess this feature in common, that they are propagated mainly or exclusively by contagion, *immediate* or mediate. Whether or not we allow the hypothesis of their *generation de novo* in any case, on this all agree that such spontaneous developments of pestilential virus are few and rare, and that if prepared to at once completely isolate and disinfect every spot where such infection has been hypothetically created, the general dread of pestilence might well be forever dismissed. With regard to many diseases, indeed there is the strongest evidence that they have never been developed spontaneously in civilized lands. The small-pox of man was unknown among the aborigines of the New World until introduced by the Spaniards, and then it virtually depopulated whole regions. It was conveyed to the Sandwich Islands for the first time in 1854, and in one year carried off 6,000 people, one-third of the entire population. European physicians exhaust their ingenuity in the construction of hypotheses to account for the disease apart from t eir own land, but no one to-day would offer the suggestion that it arises spontaneously or otherwise than by contagion in Western Europe. The bubonic plague (the black death of the middle ages) and the Asiatic cholera (the scourge of more recent times) never appear in Europe, nor indeed out of Asia, save as the result of infection from diseased subjects or the recent products of such subjects. In regard to the former we had but yesterday a most striking and instructive example of its extinction in an infected Russian village by the simple expedient of encircling the place by an impassable military cordon until the infection had burned itself out, and until disinfection had removed all danger. Thus the pestilence was confined to the few who had already suffered exposure, and a great part of the nation and perhaps of the continent was saved one of those terrible inflictions of which we read with horror in the records of the mid le ages.

No less striking are the examples furnished by animal plagues. The sheep-pox is never seen in Western Europe save as the germ has been introduced by the diseased sheep or wool, and in every case occurring in comparatively recent times the mode of its introduction has been easily traced. Rinderpest, formerly supposed to have been developed as the result of privation in travel during the great European wars, has had every extension made by it in the last fifty years traced back to its true source in the steppes of Eastern Europe and Asia. In the light furnished by the absolute proofs of contagion in every case of extension in these recent outbreaks, we can see that even in the outbreaks of more distant times the same general causes existed in every case without exception, and the inference becomes unavoidable that then as now, the disease was propagated by contagion and contagion only. A similar history attaches to the extensions of the lung plague of cattle and the aphthous fever of cloven-footed animals. No development of either disease *de novo* has ever been shown to have taken place, and all outbreaks and extensions in recent times have been easily and invariably traced to the introduction of infected animals or infected materials derived from the diseased animals.

Apart from these affections, which are now recognized, at least in Western Europe and in the western hemisphere, to be propagated by contagion alone, and in the case of diseases which most people, and perhaps even most physicians, still hold to frequently arise spontaneously, we still find this grand truth of the pre-eminent influence of contagion standing out in the boldest relief.

Glanders in horses, which is so ubiquitous that most people suppose it may arise from a cause no more specific than a *bad cold* or a *general debility*, has again and again respected certain secluded countries for a long period, and until the disease germ had

been introduced from without, when all at once it spread widely and disastrously. Charles Percival, during an eight years' residence at Meerat and Cawnpore as a regimental veterinarian, saw not a single case of glanders. William Percival, in seventeen years' service in the First Life Guards, saw but one case of glanders, and that clearly traceable to infection. Saunier, veterinarian to the King of Portugal, tells us that during his thirty years' residence, up to the outbreak of the Peninsular war, not a single case had occurred in Lisbon. Later, during and after that war, glanders became the scourge of Portugal and Spain. Krabbe records that in the island of Bornholm, with 7,000 horses, and in the Faroes and Iceland, with 30,000, glanders is virtually unknown, there being little intercourse with the outside world, and strange horses being introduced on rare occasions only. The same writer estimates the number of cases of glanders per 100,000 horses in the different countries of Europe and in Algiers, from 1857 to 1873, as follows: In Norway, 6; in Denmark, 8.5; in Great Britain, 14; in Sweden, 59; in Wurtemberg, 59; in Prussia, 78; in Saxony, 95; in Belgium, 138; in the French army, 1,130, and in the Algerian army 1,548. In this we are confronted with the striking fact that the highest losses occurred in the countries of Central Europe, where the more active commerce and the extraordinary movement and great interchange of horses furnished the best opportunity for contagion. The high and low figures for France and Britain, respectively, find a similar explanation, for in France, until quite recently, chronic glanders was not considered contagious, while in England it was criminal to expose even chronic cases, where there was a possibility of infecting others. The case of Algiers is especially instructive, the climate having been formerly held to be incompatible with the existence of glanders, but the advent of the French army and of French opinions as to the non-contagiousness of glanders, quickly showed that the alleged salubrity of the climate had little to do with the matter.

Even in the case of the influenza of horses, which so many believe to be devoid of any contagious element, and which has been supposed due to intangible influences of the atmosphere or other environment, the controlling power of contagion was shown in the facts that in the epizootic of 1871 the quarantined island of Vancouver was spared, though the pest ravaged the adjacent mainland; that the frozen-out Prince Edward Island escaped, though New Brunswick and Nova Scotia were infected throughout; and that all the West Indian Islands, except Cuba, kept clear, though all of our Southern States suffered. In Cuba, the first to suffer were horses just arrived from the United States.

We naturally divide our contagious diseases into these two great categories: (*a*) Those which are known to have never occurred on this continent and in these latitudes save as the result of contagion; and (*b*) those which are mainly propagated by contagion, but which may also, so far as we know, arise in a very limited number of cases from local unwholesome causes and apart from contagion. The diffusion and extension of the first must be considered as altogether and exclusively the result of the diffusion of the poison derived from an antecedent sick animal; and we have just seen that even in the second class of cases, so soon as contagion is rendered impossible, the disease is usually abruptly arrested. Many argue from such facts as I have presented that the second class of diseases (glanders, influenza, hydrophobia, swine plague, anthrax, tuberculosis, &c.) are just as exclusively the result of contagion from a pre-existing diseased victim as are the specific plagues, like rinderpest, variola, lung plague, and aphthous fever. I shall not ask you to give an unhesitating acquiescence to such a theory, but I do insist upon this, that the great cause of the propagation and prevalence of both classes of plagues alike, is to be found in contagion and in that alone.

TRAFFIC THE GREATEST CAUSE OF PLAGUE EXTENSION.

Having laid this basis for my further remarks, I now ask you to note that the great cause of plague extension among domestic animals is to be found in the activity of the traffic. The more numerously and frequently animals change hands, the greater the opportunity for contagion, and the lands in which the most active trade is carried on must, *cæteris paribus*, be those most ravaged by animal plagues. This holds true, as we have seen, in the case of glanders, prevailing in the more busy central countries of Europe, as compared with the commercially less active lands in the north and south. It holds good no less of the great body of animal plagues which have ravaged Central Europe, incomparably more frequently and more severely than the lands in the extreme north and south of the continent. But I must now restrict my remarks mainly to the contagia of cattle, and set forth to some extent the relationship of these to the cattle traffic as carried on under different controlling conditions.

THE CATTLE TRAFFIC AS AFFECTED BY WAR.

The controlling influence on cattle traffic which for ages contributed most to the diffusion of cattle plagues was *war*. The first record of the lung plague of cattle is

that made by Tacitus and Columella in the middle of the first Christian century. This attended and followed the great wars of the Romans, and seemed a harbinger of the mightier ills soon to come upon Europe from a similar cause. Still at this time the conquerors were extending their triumphs in an eastward direction, and as yet there is no evidence of the introduction of the more deadly rinderpest from its home on the north of the Caspian. The introduction of this dread disease into Western Europe is only recorded when, in 451 A. D., Atilla and his 700,000 Huns marched from the eastern home of the plague to Burgundy, and finally to Rome. Such a vast body of men required for their supply immense parks of cattle, and though these were constantly supplemented from the countries through which they passed, yet the plague-germ, starting with the army from the east, was only fed by each new addition of susceptible stock; and thus the pestilence was carried and diffused throughout the whole of Southern Europe.

Again, in 801, a ruinous epizootic fell on the cattle of France, supposed to have been caused by malicious poisoning of the pasturages, but undoubtedly the result of the previous operations of Charlemagne in the East, and the introduction of e plague with his returning legions.

Again, in 809–10, during the operations of Charlemagne against the Danes on the Elbe and Weser, the oxen collected for the supply of his army were almost universally slain by this epizootic, and a similar disastrous mortality obtained in all the provinces he had conquered. In the same year rinderpest was carried to and devasted England, where Egbert, friend and pupil of Charlemagne, held sway.

After a number of lesser invasions in connection with the more local wars, we read of the next universal extension, in 1233 to 1238, in connection with the Mongol invasion, and the movement of vast bodies of men and cattle from the same plague-stricken regions that sent forth the Huns. This great pestilential invasion not only overran Europe, but, like that of four centuries before, extended to England in connection with the wars of Henry III for the retention of Normandy.

Another universal diffusion of lung plague and rinderpest in Europe took place in the end of the seventeenth century and the beginning of the eighteenth, in keeping with the generally disturbed state of the Continent. Again another, in 1726 to 1730, in connection with the wars of Charles XII and of the Spanish succession; and once more again, in 1743–'45, in connection with the wars of the Austrian succession. In this latter year the rinderpest once more reached Great Britain, but this time through a strictly commercial importation. In little more than fifty years of this century it is calculated that no less that 200,000,000 head of cattle perished in Europe from rinderpest alone.

The next great extension of cattle plagues was from 1792 onward in connection with the wars attending the French revolution and the rule of the first Napoleon. In three years from 1793, it is calculated that 4,000,000 head of cattle perished in Italy alone, and other countries suffered in proportion, as they were made the theater of belligerent operations.

Another great diffusion of rinderpest took place in Western Europe after the disastrous retreat of the French army from Moscow in 1812.

Again by passing over a number of smaller extensions, we may note the infection of Egypt by rinderpest through imported steppe cattle in 1841, when Mehemet Ali was engaged in a war with the Porte, and again in 1882, when England drew cattle from the East for the supply of her army. In the first-named invasion Egypt lost 3,000,000 head of cattle in a single year; the second was speedily stamped out by the thoughtful vigilance of the veterinarians of the British army.

The last great extension of these plagues through a European war occurred during the Franco-Prussian war in 1870. The German army drew upon the East for their supplies of cattle, and wherever it went the rinderpest followed. So prevalent was the plague that of 12,000 cattle set aside for the relief of the famished Parisians on the day before the raising of the siege, the majority perished in one night and before they could be utilized.

But what, I shall be asked, has this to do with the cattle trade? It has everything to do with it. Artaxerxes, Atilla, Charlemagne, or Napoleon moving from the East, the source of the Old World plagues, with half a million to a million of warriors, and opposed by armies only less numerous, determined a concentration of cattle and the establishment of cattle markets on a scale incomparably more extensive than could ever occur in times of peace, and as the congregation of cattle was continuous without a day's interval, and the new were necessarily herded with the old, any germ once introduced into the army herds could not fail to be there perpetuated. These markets, moreover, were under the still greater disadvantage of being traveling marts, so that not only were the countries traversed infected by the diseased stock that were being drawn into the army herds, but the army herds themselves, the constant focus and source of contagion, scattered the deadly germs wherever the army marched. A stationary market, no matter how extensive, has a limited and reasonably constant area to which it supplies stock, and there is, therefore, some limitation as to the diffusion of contagion from such a center; but the infected herds of a belligerent army have

their capacity for diffusing infection limited only by the ambition of the commander or the fortunes of war. In those early ages, therefore, wars were the great causes of disturbance in the cattle trade, and in the same ratio the means of spreading pestilences. And the point worthy of notice in this connection, is that the greatest animal pestilences of Europe have always been a signal of an extensive war in which large bodies of men were led westward from the eastern part of the continent.

In all historic time the great unfenced pastoral plains of Central Asia and Eastern Europe have been the perennial home of animal plagues. Since then, a plague-germ, once introduced, found ample means of increase and diffusion in spreading from one wandering herd to another, and it never failed to quickly intrench itself widely and to defy all measures for its extirpation. Whenever, therefore, an army moved from Eastern Europe for the invasion of the West, or when a western army penetrated the East and returned, the result was unfailing that these animal plagues followed westward in its train. Another point is especially worthy of notice in regard to recent times. The western frontier of Russia is patrolled day and night by guards stationed 200 paces apart, and all cattle coming from the East are quarantined eight days to exclude the dreaded rinderpest from Austria and Prussia. In peaceful times this is reasonably successful, but on the passage of an army the commissariat parks must pass, too, and they can make no delay, but must keep pace with the troops, so that healthy and sick go on without question. Again, though the war may not necessitate the crossing of the frontier by an army, yet if the operations are very extensive, the army contractors find it difficult to replenish their parks without drawing on the great pastoral steppes of Russia, and a little gold venally employed removes the scruples of the guard and allows the admission of the dangerous steppe cattle.

Here comes a pertinent question: Why did not our civil war lead to an extension of animal plagues over the United States? It did lead to the diffusion of such plagues as were in the line of traffic. Of the horses and mules drawn into the military service, a certain number were glandered, and those who went through the war can tell how widespread was the malady in the cavalry, artillery, and commissariat ranks, and in the States where the armies operated. On the conclusion of the war, the troop horses and teams were sold and scattered, and to the present day many Northern States far removed from the sphere of actual conflict, still suffer extensively from the glanders propagated by this old army stock.

Again, so far as the supplies of beef were drawn from Texas and the other States on the Gulf coast, the infection of Texas fever was carried and sown broadcast in the routes of the armies. Conversation with members of the commissariat department furnishes me with the exact description of Texas fever in the carcasses of animals slaughtered alike in the last war and in the Seminole and Mexican wars. That the States at large did not suffer more from this cause, depended on the source of the infection and its natural restrictions. For a time the Gulf coast States were not accessible for the supply of cattle to the Northern armies, so that the infection could only reach as far north as the Confederate troops penetrated. Then the infection could not propagate itself indefinitely out of its native home. Scattered by Southern cattle on the fields and roads, it carried death to all Northern stock that took it in, but having once passed through the system of a Northern crust and fatally affected it, the germ seemed to have lost its infecting power, and there the mortality ceased. The poison, in short, lacks the power of continuous reproduction in a succession of the same systems and in all weathers, which is characteristic of the Old World plagues. Again, this plague is not deadly in cold weather. It is essentially a disease of the warm climate and season, and even after it has set in, the symptoms are usually materially ameliorated by an access of cold. Finally, the germs of Texas fever cannot survive our Northern winters. Nothing is more fully demonstrated than this, however the germ may outlive the milder winters of North Carolina and Tennessee.

During the war the lung plague was fortunately confined to the dairy herds of our large Eastern cities and their vicinity, from which no cattle could be drawn for the supply of army beef. Had it been otherwise, had this pest existed in the herds from which the army commissariat was supplied, it would have followed in the track of the troops as surely as it followed Atilla, Charlemagne, or Napoleon.

CATTLE PLAGUES AS AFFECTED BY INTERNATIONAL COMMERCE.

Next to war, in point of time if not in importance, in the propagation of cattle plagues, is commerce. With the advancement of modern science, with the development of manufactures, and with the corresponding increase of international trade, the facilities for the propagation of animal plagues were proportionately increased. The profound peace of Western Europe in the second, third, and fourth decades of the nineteenth century favored an extraordinary material prosperity, and in this agriculture and the animal industry did not fail to participate. The increased population and wealth of the large cities enhanced the demand for food staples, great distilleries

and sugar factories were built, the waste products of which were utilized for the stall-feeding of stock, and the consequent demand for lean cattle exhausted the capacity of the adjacent countries, and led, like the needs of a great army, to the drawing upon the exhaustless East for new supplies. In their turn, the vast distillery stables of the West became even more conducive to the perpetuation of disease-germs than had been the army herds. Confined under one roof, closely packed from considerations of economy, and fed in long rows from common troughs, these cattle were furnished with the most abundant means for the propagation of disease-germs when once these had been introduced into their midst. With the rise of these factories and feeding establishments, accordingly there was a steady increase and extension of animal plagues until about 1840, when some of these affections were as prevalent as after a general European war.

There was, however, a great and notable difference. To the herds of armies moving from Eastern Europe there was a daily accession of new stock, and as the slaughter was as frequent and as constant, there was little inducement to adopt any measures of preservation. Thus the rinderpest, which develops in two to four days after infection, became the most prominent pest of the army troupe, and lung plague, which remains one to three months latent in the system, was in the main overshadowed and overlooked. In the distillery stable, on the other hand, the entrance of rinderpest was the unfailing cause of a speedy and disastrous mortality, which compelled the owner at once to make beef of the whole herd and to cleanse the building ere he dared to introduce other stock. Lung plague, on the other hand, passing unnoticed for weeks and months in the purchased cattle, could not be so easily guarded against, and naturally enough came to be considered as inevitable. At that time, therefore, rinderpest was *par excellence* the plague of army herds and belligerent countries, while lung plague and the less fatal but scarcely less ruinous aphthous fever, were the plagues of peaceful times.

With the enhanced prosperity, England, at the time referred to, had developed a manufacturing and commercial community in excess of her ability to feed with home products, and was compelled to abolish her corn laws, and was persuaded, unfortunately, to repeal even her embargo on foreign live stock. The result was a rapidly increasing influx of continental cattle drawn from the infected districts, markets, and feeding-stables, and soon, with the exception of the purely breeding districts, the islands of Great Britain and Ireland were infected throughout with both lung plague and aphthous fever.

The far-reaching consequences of this blunder it is impossible to overestimate. From England, with her splendid breeds of cattle, the envy of other nations, the lung plague has been conveyed and planted in the most distant parts of the globe. European countries, which, being situated out of the direct line of the great cattle traffic from east to west, and which had hitherto escaped, were now infected by the importation of the coveted British stock. All the great colonies of England, Canada excepted, were irremediably infected, and the United States suffered, and after thirty-five years is still suffering from the importation of a single infected English cow. England has seen her error, and now demands the slaughter at the port of landing of all cattle from countries harboring lung-plague infection, but she can never undo the consequences of that one false step which has thrown a crushing incubus on the cattle industry of Australia, Tasmania, New Zealand, and Southern and Central Africa. That one false step of England is now costing the United States over $2,000,000 per annum, and unless we learn from it the same lesson that England has, and apply this to our inter-State commerce, as well as to our importations from abroad, it will yet cost us $50,000,000 or $100,000,000 annually. Each of these countries may in its turn become the means of propagating this plague to other unprotected lands, so that he would be a bold man who would seek to foretell the consequences of that one irretrievable blunder of England.

CATTLE PLAGUES IN RELATION TO CATTLE TRAFFIC BY ROAD AND RAIL.

The great development of railways has done much to modify the effects of trade on contagious diseases. Before the era of railways, when cattle moved by road, the progress of a plague was necessarily a slow one, and while there were opportunities for infection along the whole route, and while disease was communicated at every point as far as the infected herd penetrated, yet, as in the case of the more rapidly fatal plagues, the dead and dying had to be left at frequent intervals, measures were usually taken to stop their progress, and therefore, in the absence of war, rinderpest was not readily nor quickly propagated through long distances; whereas lung plague, remaining latent in the animal system for a full month, could easily be carried from one end of Europe to the other. Hence it came that during periods of peace, rinderpest rarely reached Western Europe, whereas lung plague was very widely diffused. Unfortunately for us we have to deal, not with rinderpest, which gives such timely

warning of its presence, but with the insidious lung plague, a pestilence which virtually "stalketh in darkness," and eludes all but the most careful vigilance.

With the extension of railways toward and into the infected regions of the Old World, cattle could be transported in a day a distance that formerly took a week; and apart from police and veterinary sanitary restrictions, the rinderpest became as dangerous as the lung plague. To-day, accordingly, the immunity of Western Europe from rinderpest is due only to the rigid quarantine maintained by Austria and Germany on their eastern frontiers.

In the United States, the extraordinary development of railways has introduced a danger the same in kind, though not in degree. At the close of the war, the Texas cattle, for which there had been no Northern market for four years were shipped northward in immense numbers, and everywhere the railways stood ready to convey them to the East. This culminated, in the hot, dry summer of 1868, in a widespread and most destructive pestilence among our Northern and Eastern herds, which failed, however, to bring about any satisfactory legislation by either State or Federal Government. The States that did pass restrictive and protective laws had to submit to see them declared unconstitutional, and to-day we stand open as before to have our markets and railway cars infected, and our pastures strewn with deadly germs. Fortunately for us, the ravages of this disease in the North is limited to the warm season; otherwise our present yearly losses would be magnified many thousand fold.

I speak no less in the interests of the Southern stock-owners than of the Northern, when I advocate a Federal law forbidding the passage northward during the spring or summer of any cattle south of a given line, which may be roughly stated at the thirty-seventh degree of north latitude. Such a law, besides protecting the Northern herds, would furnish a guarantee of the safety of Southern cattle, and would greatly enhance their value by introducing as buyers hosts of intelligent men who would not now in summer accept a southern herd if presented to them. It would otherwise improve the markets for store cattle in the North by drawing a class of judicious buyers, who will not now in summer frequent a market into which Southern cattle are being admitted.

Another phase of this railway question is the facility and rapidity with which cattle can be carried from our districts now infected with lung plague to the most distant parts of our possessions. Stock shipped from New York or Baltimore may reach Chicago or Saint Louis in two days and a half, and in one day more may be lodged on our fenceless plains. Numerous instances of the propagation of lung plague from our infected markets for a short distance inland have occurred in the past year. Thus from New York, extensions have been made into the counties of Dutchess, Putnam, Westchester and Richmond, and from Baltimore into the adjacent counties of Maryland, and even into Pennsylvania. What, then, is to hinder the shipment of this same disease to the plains, Wyoming, or Montana? The journey takes but three to five days, while the disease remains latent and unrecognizable in the animal system for, on an average, from three to five weeks. Formerly it was claimed that no cattle were sent west excepting thoroughbreds, and that the care with which these were kept and the character of their owners were a sufficient guarantee that no disease would be propagated through them. Yet almost every extension of lung plague from Great Britain has been through thoroughbred cattle. I need only name those into Norway, Sweden, Denmark, Oldenburg, Mecklenburg, Australia, and New Zealand. The same carefully-guarded thoroughbred cattle infected South Africa and Massachusetts. Coming nearer home, we have at different times seen this infection carried by thoroughbred cattle into the herds of Messrs. Cameron, of Staten Island, Bathgate, of New York, Morris, of Westchester, and Hoyt, of Putnam, N. Y., and Watrous, of Perth Amboy, and Taylor, of Burlington, N. J. Let us hear, therefore, no more of the immaculate nature of the thoroughbred nor of the intelligence and character of their owners who, with a disease having so long a period of latency, may be just as easily deceived as the most ignorant.

It may be argued that there are few of these sent West, and that the danger is therefore reduced to a minimum; but in this minimum quantity there is an incalculable potency for evil. One imported animal in each case infected Australia, South Africa and New York, and at times when there was next to no importation into either country. It is in the very obscurity of the single imported animal that the greatest danger lies, and for a disease which advances so insidiously as lung plague and kills its victims at first at such long intervals, an irreparable extension may be made before public attention is drawn to its existence.

But if we can no longer console ourselves with this specious delusion of the healthfulness of thoroughbreds, neither can we with the alleged smallness of the numbers shipped West. I am speaking within bounds when I say that our thoroughbred cattle now number five times what they did ten years ago. There is, therefore, at least five times the amount of traffic in this class of stock that there was ten years ago. Of the milking breeds of thoroughbreds, the great majority are resident in or

near our infected districts, and when shipped west or south, it is often from one of our great infected cities.

Nor are our shipments westward now confined to the thoroughbreds. The trade in eastern calves and yearlings to be matured and fattened in the West, grew in three years to great dimensions, and in spite of heavy losses from exposure and in spite of the salutary warnings of the Treasury Cattle Commission and the prohibitory proclamation of Governor Cullom, of Illinois, it still persists. Worse than all, the exhaustion of the supply in the safer Western districts of our seaboard States has driven the dealers during the past year into the infected districts and markets to fill their orders, so that cattle have been sent West from some of our worst infected markets. At the market of Camden, N. J., last autumn I was told that over 100 store calves were sold weekly, and that a large number of them went West. It is true they had been inspected in the market and their purchaser received a certificate of soundness, but inasmuch as no one can detect this disease during its long period of latency, such a certificate was far more likely to prove a snare to the confiding than a valuable guarantee.

These young cattle are common stock, and are purchased at the lowest price obtainable; there is, therefore, every reason to fear that among them may be found occasionally, animals picked from an infected herd which the owner is anxious to get rid of at almost any sacrifice. These young cattle are shipped further West in the cheapest way, or, in other words, in the common, uncleansed, cattle-cars, and the fodder supplied to them is obtained in an infected district. There is, therefore, reason to fear that some of these young scrub stock are actually drawn from infected herds, while of the others there is reason to apprehend infection from the cars in which they are brought to market, from the animals met with in the market, from the market yards in which they are detained, from the cars in which they are shipped from the market, or from the fodder supplied to them on their journey.

Our dangers in this respect are enormous; our precautions are almost practically *nil*.

CATTLE PLAGUES AND CATTLE TRAFFIC BY SEA.

The relation of ships to the propagation of cattle plagues is a very important subject; but inasmuch as the present Treasury quarantine of imported cattle should be a guarantee against the importation of disease by this channel, it may be dismissed in a single sentence or two. Confinement between close decks and the breathing of impure air may suffocate the stock or generate lung diseases, but it never has generated, and, so far as we know, never can generate an animal plague. The confined area between decks is one of the best possible places for preserving and propagating a disease germ which has been introduced from without, but in the absence of the germ, the confinement can only injure the individual animal subjected to it.

CATTLE PLAGUES IN THEIR RELATION TO MARKETS.

In infected districts markets are among the most prolific means of propagating pestilences. Where markets are open for the reception of cattle from infected districts, as well as sound ones, no cattle can be safely purchased in these markets. The chances of infection from infected yards and fodder, from contact with infected animals and persons with infected clothing, and uncleansed cars and other objects in going to and from the mart are great, and wise men habitually avoid such places in seeking store cattle. In all countries where it is attempted to stamp out cattle plagues, open markets for store cattle are prohibited, and those places are left open only for beef-cattle doomed to immediate slaughter.

Yet in all our infected States in which we are professedly attempting to *stamp out* lung plague, the public markets are maintained open to all kinds of cattle, store and beef, and from all sources. For some of these marts in New Jersey there is the empty formality of an inspector, but as he can know nothing of the herds from which the cattle are drawn, and as it is impossible to detect the lung plague in its initial latent stage, his value and importance can hardly be underestimated.

In New York, in 1879, I secured a special market for store cattle, to which stock were admitted only from districts known to be healthy, and from which alone cattle were allowed to go out to join other herds; and this, with a rigorous inspection and control of the herds, virtually cleared the city of the pestilence in the course of three months; but when I left the State service, in 1880, all was changed. The money could not be afforded to maintain a pure market, nor the systematic and thorough inspection of herds; the markets were made common as before, and almost all the precautions hitherto adopted were thrown to the winds. The result was the speedy infection of four counties which had been laboriously and expensively purified of the disease, and of a fifth into which the plague had never penetrated before. One sufferer in Dutchess County sent his whole infected stock to be sold in the Union Stock Yards, New York, while a Westchester County sufferer had his cattle, sick and infected

alike, sold by public auction at the same place, in the basement of the sheep-house, which is used in winter for the shelter of fresh milch cows, and which had been disinfected at a heavy outlay in 1879.

The sound course in relation to this matter is to establish in infected districts two sets of cattle markets entirely distinct from each other. *One* for *fat cattle* only, destined to immediate slaughter and without any intervening exposure in any public place; and a *second* for *store cattle* only, or for both *store* and *fat cattle*, but into which no animal from an infected or proscribed district shall be admitted.

To the *first market* may be admitted cattle from all quarters infected and uninfected, but from it not one should be taken for store purposes. Every such market should have an extensive abattoir, and the stock entering the market should be allowed only to pass out in the condition of beef.

In this connection, I must commend the restriction of the slaughtering business in any city to one central abattoir. Private slaughter houses are expensive, deficient in proper appliances, filthy, unfitted for inspection, and dangerous at once in throwing unsound meat upon the market, and covering up the traces of animal plagues.

To the *second*—the *store market*—can be sent all animals, fat or lean, provided they come from sound districts. To this, farmers, dairymen, and others in search of store cattle, may come with confidence to replenish their herds, and from this butchers may take fat stock to be slaughtered in neighboring towns, and exporters may send shipments across the ocean with a guarantee of health.

With these two classes of markets rigorously maintained, a speedy end would be put to the present system of making every market in an infected district a hot bed of infection, and a center from which disease is being continuously diffused.

OTHER CATTLE TRAFFIC IN INFECTED DISTRICTS.

Turning to the more private forms of cattle traffic in infected districts, we are again confronted with a prolific source of disease. The unscrupulous sell apparently sound cattle taken from infected herds; the careless expose them to infection in resting over night in yards and buildings, of which they know nothing, in passing other herds on highways or in adjacent fields, and in loading them in uncleansed cars from similarly filthy yards and chutes; finally, even the careful expose their stock unwittingly on roads recently traversed by the sick, to drink from public troughs where the sick have preceded them, and perhaps by supplying fodder in transit that may be infecting. All movement of cattle in an infected district should be prohibited excepting from herds that have a professionally attested soundness for at least three months antecedent, and to which no addition from without has been made unless it be from a similarly attested herd. If all herds within the infected area are regularly examined and registered, there can be no difficulty in carrying out this precaution.

LOCAL TRAFFIC THROUGH DEALERS' STABLES.

Of all modes of local traffic, that which passes through the stables of a dealer is incomparably the most perilous. The dealer lives by buying in a cheap market and selling in a dear one. In infected districts, the possibilities of buying low-priced animals from infected herds draws into the business a certain number of unscrupulous men who do not object to turning a dishonest penny, and the stables of such men necessarily become concentrated foci of disease. Even the dealer who scorns such dishonesty is at a tremendous disadvantage in such places. With all his tact and shrewdness he can, no more than the *expert*, tell whether an animal offered for sale is or is not in the preliminary or latent stage of the lung plague, and sooner or later—usually very soon—he becomes the unfortunate possessor of one or more infected animals. Thus his stables are infected, and every animal that enters them thereafter is subjected to infection. In an infected district no one can safely buy from a dealer, and if he takes in animals that have passed through a trader's stable, he can hardly fail to have taken in disease.

The only safe course is to abolish all such dealers' stables and to allow cattle to move only from the store markets or from one attested herd to another under a special license.

TRAFFIC IN THE CATTLE OF CITY DAIRY AND FEEDING STABLES.

There are two great causes of the maintenance and propagation of cattle plagues in cities. *One* is the contagion resulting from the pasturage of herds on unfenced lots and commons, or in pastures adjoining each other. *The other* is the vicious condition of the local cattle trade. With the first it does not fall to us to deal at present, though its abolition is an essential step to success in dealing with cattle plague. The *vice* of the *city cattle traffic* may be stated succinctly. In infected cities the dairyman usually obtains his stock from common, that is, infected markets. If not from the markets, he gets them from the dealer's stable, to which they have been removed from the market

and where they have been subjected to a second and still more concentrated hot-bed of contagion. The city dealer not only fills his stable from the infected market, but he also returns to it cows that have been sent out to dairymen on trial and which have proved unsatisfactory because of failing health and milk. In four cases out of five, this failure is due to the lung plague, so that that is planted among the fresh and susceptible animals which are being sold off as rapidly as possible to other dairymen. Of all nests of infection, therefore, the stable of the city cow dealer is incomparably the worst. If, as occasionally happens, he is at the same time a butcher, the infection and infecting power of his stables usually reach their acme.

But to proceed with the list of evils in the city cow trade. The diseased cow which has proved objectionable to *one* dairyman, is often passed on on trial to a *second*, and if the case should unfortunately prove a mild one, a *third*, *fourth*, and *fifth* dairyman may receive the sick cow in succession, the drooping animal proving satisfactory to none but leaving a legacy of disease and death wherever she is admitted. A cow of this kind far more than pays herself to the dealer by the empty stalls that soon appear in the dairies she has visited in succession and the lively demand for fresh cows that follows. Then again, many of the poorer dairymen are absolutely at the dealer's mercy. Hardly a cow in their stables are their own, but they have agreed to take them at nearly double their real value, and on this fictitious price the most usurious rates of interest are exacted, so that it is hardly possible for them to keep their heads above water. They dare not refuse to take new stock at the dealer's own price, nor even decline to take in a sick cow, lest their hard taskmaster should foreclose his mortgage and rob them of their very living. They dare not report disease to the authorities except it be with the sanction of the dealer and thus the infection is hidden away as long as possible, and if finally discovered and the reputed owner is made to suffer for disobedience of the law, the real culprit who held this man's very soul in his relentless grasp, escapes.

Then the great swill-feeding stables in the cities and suburbs are continually being replenished by cows from these city dairies. A cow that has survived a period of sickness and having dried up in her milk, is now worse than useless in the dairy, is a desirable acquisition, at an extremely low price, to the swill stable. She brings in the infection which never again leaves the building, but is kept up by a steady propagation and by constant accessions of the same kind. For all this vicious system of city trading there is but one remedy.

Abolish the dealers' stables; let no animal enter a city dairy nor swill stable except by permit from districts known to be healthy or from the store cattle markets which are carefully guarded from infection; prohibit absolutely the passage of any bovine animal from one city stable to another; and prohibit the exit of any bovine animal from any city stable except under permit and for immediate slaughter. With such provisions, the extension of lung plague or other cattle plague within a city would be rendered almost impossible, and this attained it would be very simple and easy to *stamp it* out.

The vicious systems of pasturage and trade which I have briefly narrated, have been the real causes of the permanence of the contagion of lung plague on this continent, and so long as they are allowed they will almost infallibly defeat the most strenuous efforts to stamp out this exotic pestilence. In secluded herds on well fenced farms, this pestilence, indeed almost any pestilence that is purely contagious, is self-limiting.

If there is no contact with adjacent herds, no ingress nor egress, and an absence of a constant succession of births of fresh and susceptible young, the fire of contagion soon burns itself out and after a time the very germs, laid up in the building, tend to become aerated and disinfected. In well fenced country districts, nothing is easier than to stamp out these animal plagues, and those who have dealt with them only as occurring on well fenced farms have no conception of the sleepless vigilance and the multiplicity of precautions demanded in dealing with a large infected city. It is in our cities that the final battle must be fought and the triumph won, if it ever shall be won. No measures for the control of interstate traffic essential as this is to prevent extension nor country traffic, can ever rid us of this cattle lung plague. The trade in the cities must be radically changed, the dealers' stables must be abolished, the too frequent connection of dairy and feeding stables and slaughter-houses must be done away with, the movement of cattle from stable to stable must be stopped, and the removal for store purpose of cattle from any city herd, must be for the time prohibited.

Procrastination in these matters is prodigality. We are yearly losing on our exports alone more than enough to purge the United States once for all of this exotic curse. Every day of delay endangers the extension of the scourge to our western and southern unfenced pastures, to which, not even the measures above-named are applicable, and from which the plague could only be extirpated by the extermination of the whole race of animals—domestic cattle and buffaloes—which are susceptible to its attacks. So long as it is confined to fenced farms it may be exterminated, the expense of course increasing in ratio with the area infected, but when it reaches the fenceless plains and prairies it will pass at once from our control. We shall be con-

fronted with difficulties similar to those met with in the cities, but on an incomparably vaster scale, and without any of those police facilities which are at hand in the city. In all such infenced countries where this plague has been planted, it has successfully resisted all control; in the steppes of Asia and Europe, in Australia, in Tasmania, in New Zealand, and in South Africa. In no one instance has the result varied and it cannot be hoped that we shall fare better in this respect than others. Even Australia, which boasts of one of the most favorable climates in the world for weak chests, squandered fabulous sums of money and killed whole holocausts of cattle in the vain hope of stamping out this contagion. It came to be seen that to exterminate the disease they must exterminate their herds, and thus this great source of the country's wealth was clouded forever. We glory over the successful extinction of this disease in Massachusetts, but the sacrifice and effort made in Massachusetts was not to be compared with the lavish expenditure and Herculean struggle of Australia, but what was plain and easy in the inclosed fields of the Bay State, was absolutely impossible on the boundless open ranges of the island continent.

I would like to take up other phases of this subject, but having already tired your patience beyond all due limits, I shall close by drawing your attention to a table seting forth the profit and loss account in this matter. The estimate of our probable losses in case of the infection of the West, are drawn from the losses of England on a very much bounded population. The cattle of England are given as 6,000,000 head, while those of the United States cannot now number short of 40,000,000. To have based the estimate on the higher percentage of deaths in South Africa and Australia, would have made a far more striking showing, but to avoid any possible exaggeration I prefer to take the lower percentage of mortality in Europe.

Present yearly losses from lung plague in United States, $2,000,000 to $3,000,000.	
Prospective yearly losses from lung plague in the United States	$66,000,000
Capital represented by the present yearly losses at 5 per cent	$60,000,000
Capital represented by prospective yearly losses at 5 per cent	$1,320,000,000
Sum required to stamp out lung plague in the United States	$2,000,000
Cost of stamping out lung plague once for all	$2,000,000
Capital required to stamp out lung plague	$2,000,000

It will not do, however, to forget that a most important feature of lung plague is its tendency to become increasingly formidable in proportion to the heat of the climate. Thus in Central Europe and England it may destroy but 10 or 12 per cent., whereas in Australia it slew 500,000 out of 2,000,000 in one year, and in South Africa it cut off complete herds of 200 or 300 cattle each, without sparing a single animal. In case, therefore, of the infection of the West and South, which seems now impending, and indeeed inevitable unless we promptly take measures to prevent it, our stock owners cannot hope to get off with the low mortality of England. In the hot summers of Texas and the Mississippi Valley, it would be in keeping with the precedents of Australia and South Africa that the losses should approximate 80 or 90 per cent. Should such a calamity fall upon our great southern stock ranges, the owners must thank themselves for having turned a deaf ear to all our warnings during the golden opportunity for prevention and limitation and extinction of the plague.

Mr. SANDERS, of Illinois. Professor Law has presented this subject, which is certainly one of the most important practical questions commanding the attention of this convention. I am well aware that many of the gentlemen now present have come with the especial purpose of doing in Washington, at the seat of the law-making power, what they could to influence legislation upon this very question. It is well enough for us to look at this matter in a practical light. We are now nearing the close of an expiring Congress; but a few weeks remain, and the question for us to consider is a practical one—not what we would recommend *de novo* if we had the time or opportunity to bring this matter to the attention of members of Congress, and endeavor to induce them individually to appreciate the facts. We have simply a few weeks before us in which to act. Now, what can we do? What is there that can be accomplished by the gentlemen who are present here? There is no question in my mind but that a true and wise economy would dictate that Congress should make a liberal appropriation of money, to be expended under some sort of authority and under such restrictions as in its wisdom it might devise, to stamp out this disease. As Professor

Law has well shown, we are losing more every year by the prevalence of this disease than most people are aware, and losing it for the people of Illinois, Kansas, Nebraska, Tennessee, Colorado, and the western Territories, simply because we have this contagion along our seaboard. We are losing more annually than it would cost to stamp it out once for all. But every one who has had any experience in looking after this and kindred subjects, knows that it is idle for us to attempt at this stage to get a large sum out of Congress.

There is a bill pending in the Senate that passed the House in June last, known as the "Hatch bill," which, while it is very far, I am free to confess, from being what I would recommend and very far from all that I think we ought to have on this subject, yet it is a very important step in the direction of stamping out contagious pleuro-pneumonia. It is also an important step toward enabling the Commissioner of Agriculture to look after contagion to farm stock generally throughout the United States, and to provide for a veterinary surgeon in the Department of Agriculture for the express purpose of investigating animal plagues, devise means for their extinction and preventing their spread—an official the Department ought certainly to have.

This bill provides a penalty for any person or corporation which transports from one State to another, animals or farm stock infected with any contagious disease, and especially pluro-pneumonia and punishes by heavy penalty the individual or corporation transgressing the law. While probably it would be exceedingly difficult to make a case against any railroad or against any individual for the transgression of that law (because I do not think there would be very many cases of willful violation of it), yet it certainly would be a very important make-weight with us to have such a statute. While I have little faith in the operations of such a law as the means of actually preventing the spread of the disease, yet, as I say, it is good so far as it goes, and inaugurates a principle which ought to be recognized. The only measure that can actually prevent the spread of this disease is one that shall make it absolutely impossible for the cattle of any infected district to be transported out of that district; but we cannot get such a law as that.

It strikes me that, by concerted action on the part of friends of such legislation, we may do something, and if the gentlemen present will work and talk with members of the Senate with whom they are acquainted, we may procure the passage of the "Hatch bill" before the adjournment of the present Congress. That being the case, it seems to me this is a practical measure for which to work.

The measure introduced by ex-Governor Carpenter, of Iowa, in May last, is, I think, the bill which ought become a law, but it is useless now, because we cannot get it. The "Hatch bill" is wise so far as it goes, and under the able supervision of our Commissioner of Agriculture, who has had a great deal of experience with the control of that disease in Massachusetts, and with the power placed in his hands toward co-operating with State authorities, much can be done and a beginning made, which I hope will be followed up at the next session of Congress. I believe, under this law, with a sufficient appropriation in the hands of such an energetic official as Commissioner Loring, we may be able to stamp out the disease from our borders. I do not think, however, this appropriation is large enough. The "Hatch bill" appropriates the pitiful sum of $50,000, but with that a beginning may be made.

The Commissioner may send his agents into the States to consult with and call the attention of the State authorities to this disease, and

induce them to stamp it out, just as the agents of the Department have been doing in the past.

The Treasury Cattle Commission has been doing likewise in Maryland, where it has been announced in the papers, apparently by the sanction of the governor, that there was no such thing as pleuro-pneumonia. I believe I do nobody injustice when I assert that an official statement of that character was made. I know that, in my capacity of journalist and treasurer of the cattle commission, I was in receipt of hundreds of letters complaining that the members of the cattle commission were treating Maryland as infected, whereas there was not a single case in the State and had not been for six months. I had many personal letters from gentlemen whom I knew, who believed what they said, that there was certainly no contagious pleuro-pneumonia in the county of Baltimore. Still, it did not take the Treasury Cattle Commission nor its agent long to find any amount of pleuro-pneumonia in Baltimore, nor did it take them long to discover that cattle from infected herds were being driven along the highways twenty, twenty-five, and thirty miles to markets in Baltimore. The cattle men of Baltimore held meetings, and the railroads took steps to try and stamp it out. I hope no one will oppose this Hatch bill because it does not go far enough, since it is, as everybody will admit, a step in the right direction. I suppose everybody present who pays any attention to the matter knows what the "Hatch bill" is, and I propose, Mr. President, the following resolutions:

Resolved, That this Convention desires to express, in the most emphatic manner possible, its opinion that it is the duty of the Senate to promptly pass the bill known as the "Hatch bill" (House bill No. 896), which passed the House in June last, and is now pending in the Senate.

Resolved, That a committee of seven members of this Convention be appointed to bring the importance of this measure to the attention of the Committee on Agriculture of the Senate of the United States.

General N. M. Curtis, of New York, explained the several provisions of the Hatch bill.

The resolutions were then adopted.

Mr. SANDERS, of Illinois. While upon this subject, I have one other resolution which I would like to offer for the consideration of this Convention, because it is a very important matter. It is with reference to the quarantine of imported cattle. It is supposed here that exotic plagues—this lung plague—is imported into this country, and notwithstanding we may stamp it out to-day, we are liable to import it to-morrow, and the Secretary of the Treasury has very wisely, under an implied authority of law, ordered a quarantine of imported cattle. At the last session of Congress a small appropriation was made to enable him to build sheds for the accommodation of cattle imported into the United States, where they might be left under quarantine and strict governmental inspection until such time elapsed as should satisfy the Secretary of the Treasury or his advising officer that there is no further danger of their harboring this disease. Under that appropriation the Secretary has proceeded to make provisions for this accommodation at Portland, Boston, New York, and Baltimore, and sheds are now being erected at those points. But the appropriation is a small one, and it is necessary, in order that this may be kept up, that Congress shall make further appropriations.

In order that the quarantine may be extended to other ports, it is necessary that we should have additional accommodations of that kind. I suggest the passage of another resolution on this general subject, so

that Congress shall know that the cattle-raisers and farmers are in favor of this quarantine, and that we want a quarantine under strict governmental restriction. I offer the following:

Resolved, That this Convention heartily indorses the action of the Secretary of the Treasury in ordering and enforcing a strict quarantine of all cattle imported from foreign countries, and in perfecting arrangements by which this quarantine may be under rigid governmental inspection. And we urge upon the present Congress the importance of making a suitable appropriation to enable the Secretary of the Treasury to continue this work and to maintain a rigid veterinary inspection and supervision over the same.

The resolution was agreed to.

The PRESIDENT. The chair will appoint as the committee of seven in regard to the "Hatch bill," Messrs. Sanders, of Illinois, Coffin, of Iowa, Law, of New York, Baker, of Ohio, Conrad, of Virginia, Gold, of Connecticut, and Grinnell, of Massachusetts.

The next paper before the Convention is one by Mr. Richard V. Gaines, of Virginia, on the "Animal Industries of the United States with especial Reference to Breeding of Cattle, Horses, &c."

Mr. GAINES, of Virginia. Mr. President and gentlemen of the Convention, I wish to preface my remarks by stating that the table of figures to which I give reference here, is compiled by valuable aid from two articles published in Bradstreet's World, in the month of December, and Mr. M. G. Muldrom, Fellow of the Statistical Society of London.

Mr. GAINES then read the following paper:

THE ANIMAL INDUSTRIES OF THE UNITED STATES WITH ESPECIAL REFERENCE TO BREEDING OF CATTLE, HORSES, &c.

By RICHARD V. GAINES, *of Virginia.*

The new year opens auspiciously for the agricultural interest of our country. A kind Providence has blessed us with abundant crops. The products of our fields and workshops are commanding remunerative prices in the markets of the world and all classes of society find ready employment, while the means of subsistence are abundant and cheap.

The labor question, which twelve months ago threatened such serious consequences to the industrial interests of the country, has been amicably adjusted. The mania for speculation, which swept like a tornado over the cotton, provision, corn, and stock exchanges of the country leaving havoc in its train, has at last subsided and business assumed its normal condition. The signs of the times point to a year of peace, prosperity, and plenty.

The unparalleled progress that has been made in all the industrial arts, the facility with which the great problems of commerce, finance, and government have been solved and the harmonious co-operation of all the diversified interests of our country in relieving want and in elevating the standard of manhood and morality, give assurance of the virtue, intelligence, and patriotism of our people, and point to the development of a higher civilization. Let us this day render devout thanks to the Giver of all good, that we are permitted to meet here in the Capital of our nation, representatives from every part of its vast domain, and from all its diversified agricultural interests, and let us renew our oaths of fidelity to the Constitution of our fathers, to the peace and prosperity of our country, and to the perpetuity of its institutions.

ANIMAL INDUSTRIES OF THE UNITED STATES.

The intimate relation existing between pasturage and tillage, the interdependence of the pastoral and agricultural industries of the country are such that the intelligent consideration of one necessarily involves to a greater or lesser extent the discussion of the other. "Pasturage and tillage are the two breasts of the State." The one is the natural complement and counterpart of the other, while the former is more ancient and has always been considered highly honorable, yet without the latter it reduces man to a condition of semi-barbarism. The progress and successful development of these two industries give assurance of prosperity to a people, while their decline is always a source of serious alarm. Hence it is considered the paramount

duty of a State, not only to remove all barriers to their successful prosecution, but also to foster and develop them by all legitimate means at its command.

It is peculiarly gratifying to note the progress that has been made by these two industries as exhibited by the last census. The grain product of the country has been increased during the past decade from 1,390,000,000 bushels in 1870, to 2,718,000,000 bushels in 1880—about 100 per cent.; giving 35 bushels to each inhabitant in 1870, and 54 bushels in 1880. In studying the census tables we find that this rapid and unparalleled extension of our agricultural interests has not been made without some encroachments upon pastoral farming. In order that we may take a wider range and trace more clearly the development of these two industries, let us compare the results of the past thirty years as exhibited by the following:

In 1850 we had under tillage 61,000,000 acres; pastoral, 232,000,000 acres; aggregate, 293,000,000.

In 1880 we had under tillage 161,000,000 acres; pastoral, 341,000,000 acres; aggregate, 502,000,000 acres.

This shows that while the area devoted to pasturage has increased less than 50 per cent. during this period, that brought under the plow has increased 300 per cent. To take another view, while the whole area reduced to farms, including pasturage and tillage, has doubled during this period, that brought under tillage has trebled. Although population increased 100 per cent. during the same period, the number of acres tilled to each inhabitant increased from 2.68 in 1850 to 3.30 in 1880, or 30 per per cent., and the acreable product increased from 14 to 16 bushels, including all crops. In consequence of this rapid expansion of our agricultural interests, the acreage value which in 1850 was $11, had risen to $22 in 1880, and is now estimated at $25, including buildings at each date.

In spite of these encroachments of tillage upon pastoral farming, it is gratifying to note that the animal industries of our country have more than kept pace with the growth of population, as follows:

Year.	Population.	Cattle.	Rates per inhabitant.	Per acre, pasture cattle.
1850	23, 000, 000	540, 000, 000	$23. 00	$2. 30
1880	50, 000, 000	1, 820, 000, 000	36. 00	5. 30

Thus we find that while population has increased rather more than 100 per cent., cattle have increased nearly 350 per cent. during this period. We also find that the average value of cattle to each inhabitant has risen 57 per cent., and that every acre of grazing land now stands for or carries 2½ times the value in live stock that it did thirty years ago. This result is due partly to increase in numbers—cows having risen 37 per cent. and sheep 82 per cent. since 1860—partly to the introduction of improved breeds and to the enhancement of prices, but mainly to the better development of our country's resources through the expansion and perfection of our railway system, which has brought to our doors the markets of the world.

I would ask your attention to another significant and remarkable fact. Wonderful as has been this unparalleled development of these industries, the capital invested in pasturage and tillage, including lands, buildings, implements, cattle and crops, ans not kept pace with the increment in national wealth, as is hereby exhibited:

Invested national wealth.

Year.	Agricultural industries.	Other investments.	Total.	Ratio per inhabitant.		
				Agricultural.	Other.	Total.
1850	$4, 528, 000, 000	$2, 902, 000. 000	$7, 430, 000, 000	$196 00	$124 00	$320 00
1880	17, 140, 000, 000	25, 120, 000, 000	42, 260, 000, 000	343 00	502 00	845 00

Thus showing that while the capital invested in tillage and pasturage has been quadrupled during this period, that invested in other industries has increased more than eight fold. And the aggregate capital invested, or total increment of national wealth, has been sixfold. In other words, while agricultural and pastoral capital constituted more than 60 per cent. in 1850, it now represents less than 40 per cent. We also note that while the increase in agricultural wealth has been rather less than 100 per cent., the increase in other wealth is more than 400 per cent., and the aggregate increase nearly 300 per cent. This clearly demonstrates the fact that while agriculture may give a better

guarantee for honest living and afford a safer investment for capital, it has not been so profitable as other pursuits. When we consider that in Europe the production of grain has not increased during the last ten years, while population, in spite of emigration, has risen 24,000,000 of souls, and that the ratio of cattle to population is declining rapidly, we need no longer apprehend that American agriculture may increase so fast that the world will be unable to consume its products. On the other hand, have we not just cause for apprehension, when we consider the prodigality with which our public domain has been donated by the Government—the rich corporations and powerful monopolies which have been created by its bounty, and are sustained to a large extent by a tax upon the capital invested in agriculture—lest the development of its interests may be seriously impeded, if not entirely arrested? Indeed, is it not an indisputable fact, that large districts in the eastern and southern portions of the country, which have been devoted for generations to the production of those great staple crops out of which this vast wealth has been created, are already to a large extent exhausted of their fertility?

A most important question, and one to which I invite the earnest consideration of this body, is, what can be done to restore the drooping agricultural interest of this section to its former condition of prosperity? Would it not be a wise and beneficent measure to set aside for this purpose a portion of the public lands, which have been given away during the past decade at the rate of 10,000,000 acres per annum? The proceeds arising from the sale of these lands would be ample to establish and maintain in each geological district an "experimental station," after the order of those which have been found so valuable in Europe and in some of the Northern States. By this means the problem of how to cultivate these exhausted lands with profit to the owner, and at the same time restore their fertility, may be successfully solved. Farming is no longer a rude art, prosecuted by clodhoppers, but a science, which claims among its votaries men of education, who demand for their guidance the best lights of the age.

No act of Congress has met with more universal approbation than that establishing agricultural and mechanical colleges in each State by the donation of public lands. This was a step in the right direction, the beneficial effects of which we are just beginning to realize. The influence and usefulness of these institutions would be vastly augmented by the establishment of these experimental stations, one of which in each State should be operated in conjunction with them. The experiments which have been made at these stations in breeding, feeding, and fattening stock, in the testing and dissemination of seeds and the propagation of plants, in the analysis of food products and fertilizers, as well as the experiments with fertilizing elements and compounds in the field, have been of incalculable benefit, and demonstrate conclusively that the drooping agricultural interests of a large section of this country cannot be rehabilitated without the direction and assistance of these institutions. Permit me, as one of the delegates from that once fertile but exhausted section, to earnestly invoke the co-operation of the members of this Convention for the accomplishment of this object.

THE HISTORY OF THE HORSE—HIS VALUE AND USES.

Let us now diverge from these general remarks suggested by the consideration of the animal industries of the country, in which my object has been rather to suggest facts for our future consideration than to discuss them, to the second branch of our subject. Of all the animal kingdom, the horse is probably the best gift of a kind Providence to man. In intelligence, docility, beauty and utility he surpasses the whole brute creation. From the earliest ages he has been the companion and helpmeet of man, both in peace and war. He cheerfully co-operates with him in the pleasures of the chase, the labors of the field and the conflicts of battle. His eye sparkles with emulation on the race-course, and flashes with fire at the noise and tumult of arms. He bends his body to the rider, and his movements are equally repressed or stimulated by the gentle hand of kindness. His whole powers are entirely subservient to the will of his master, and his life is offered a willing sacrifice to gratify his pleasure or ambition.

These valuable qualities of this noble animal have made the breeding and training of horses industries of the highest importance to civilized man. They have furnished both employment and amusement to the wisest sages and greatest heroes of ancient and modern times. It can be shown, from the earliest periods of history, that nations have advanced in civilization, made progress in the arts of peace and war, in proportion as they have made this useful animal subservient to these purposes. According to sacred history his first domestication was in Egypt, the cradle of civilization. During the seven years' famine, when other means were exhausted, "the Egyptians brought their cattle to Joseph, who gave them bread in exchange for their horses and their flocks." A few years later, when the remains of his father, Jacob, were taken from Egypt to the land of Canaan for burial, we are told that there went up, as an escort, "both chariots and horsemen." Some six hundred years later, when Solomon was collecting his treasures from all parts of the habitable globe, we are told that "it

was from Egypt that he obtained horses." From which may be inferred that in Egypt, or in Arabia, immediately adjacent thereto, the horse had its origin, or was first domesticated. It is worthy of note that in all the early records, both by sacred and profane writers, this noble animal is mentioned in connection with warlike pursuits, while the ass, the mule, the ox, &c., are devoted to purposes of peace. One striking exception to this rule, however, is noted in the sacred record. Absalom, the rebellious son of King David, rode a mule. When the battle was joined in the wood of Ephraim, in the midst of the carnage of that eventful day, "the mule ran under the thick boughs of a great oak, and he was taken up between the heaven and the earth; and the mule that was under him went away. And Joab, the commander of the host of David, took three darts in his hand, and thrust them through the heart of Absalom, while he was yet alive in the midst of the oak."

Coming down to a still later period, we find that the only nation of antiquity which resisted successfully the Roman yoke were the Parthians. Plutarch tells us that the achievements of this proud and warlike people were due less to their valor in arms than to the excellence of their horses. It was their common method not to accept a pitched battle with troops in any degree their match. Being all mounted, owing to the swiftness and durability of their horses, they advanced and retreated with equal facility, fighting all the while. When their rich territory was first invaded by the avaricious Crassus, they utterly annihilated him, with his army of 30,000 Romans. Mark Antony, one of the most brilliant soldiers of antiquity, who contended with Octavius for the empire of the world, after having overrun and brought under the Roman yoke all the nations on the eastern shores of the Mediterranean, invaded Media with an army of 100,000 men. After having beaten the Parthians in eighteen engagements, with a loss of 20,000 foot and 4,000 horse, he was compelled to withdraw his army, not being able to prosecute his advantages on account of the superiority of the Parthian cavalry.

But to come down to more modern times. In our recent "unpleasantness," to our cavalry, mounted upon thoroughbred chargers, are due the most brilliant achievements of Southern arms. The absence of Stuart, with his cavalry, caused the loss of Gettysburg—the turning point in the great rebellion. Could General Lee have mounted his army at Petersburg, in the spring of 1865, the war might have been prolonged indefinitely.

BREEDING OF HORSES, AND THE BEST BREED, ETC., FOR THE UNITED STATES.

In examining the numerous breeds of horses found on the various parts of the globe, both in a state of nature and under domestication, we are struck with an almost endless variety of size, form, color, action and adaptation. The question involuntarily arises, whence these differences? If this question can be successfully answered, then we have the key to the problem of breeding.

The doctrine formerly held by naturalists, that the distinct species of plants and animals which we find scattered abroad over the earth were created in the localities where we find them, and each adapted by nature to its surroundings, has given way under the researches of Mr. Darwin and other naturalists of the present day. If we accept the Mosaic account, which gives us one pair, handed down from the ark about four thousand years ago, the difficulty is by no means removed. What was the type of this original pair from which have sprung alike the English cart-horse and the Arabian courser, the Norman-French and Shetland pony? Under what influences have these great diversities been wrought? Mr. Darwin, in his work upon the origin of species, expresses his sincere conviction, after many years of laborious research and patient study, that not only the horse but all the species of the equine genus are descended from one common parent, probably a dun-colored animal, striped like a zebra, but perhaps otherwise differently constructed. The great varieties which we find at the present day have been developed in the course of many thousand generations by the operation of laws which he has clearly defined. Whether or not we accept the conclusions of Mr. Darwin, the principles he has laid down are eminently practical, and may be applied to the breeding of all domestic animals.

First, he has pointed out that there is in all organic beings an inherent tendency to variation, which, in our ignorance of the laws which govern it, is said to act spontaneously.

Secondly, that any change in the conditions of the life of an organic being acts on its organization and causes it to vary. This is illustrated by the effects of domestication upon wild stocks, and *vice versa*, and also by changes in climate, food, &c., as well as by habit and the use and disuse of organs.

Thirdly, that the first slight changes in the conditions of the life of an organic being add to its vigor and fertility.

Fourthly, that the crossing of forms which have been exposed to slightly different conditions of life, or which have varied, favors the size, vigor and fertility of their offspring.

Fifthly, among all organic beings throughout the world there follows inevitably from their high geometrical increase (more being born than can possibly survive) a struggle for existence.

Sixthly, in these struggles for existence, it follows that any being, if it vary however slightly in any manner profitable to itself, under the complex and sometimes varying conditions of life, will have a better chance of surviving, and thus be "naturally selected."

Seventhly, these variations and individual differences, which are in any way beneficial, preserved and accumulated under the strong principle of inheritance, will tend to propagate its new and modified form, and thus perpetuate the "survival of the fittest."

Lastly, under the operation of these laws, the older and more imperfect forms of organic beings are extinguished, while higher and more perfect ones are being constantly developed.

There are two other principles in operation to which he has called attention, viz, the law of correlation, by which he means that the whole organization is so tied together during its growth and development that when slight variations in one part occur, and are accumulated through natural selection, other parts become modified; and secondly, the law of compensation or balancement of growth, by which nature, in order to spend on one side, is forced to economize on the other.

We are now better prepared to understand how, under the operation of these laws, modified by external circumstances, the many different varieties of the horse species extant have arisen. This noble animal, under the plastic hand of man, has been molded in the process of time into just those forms which answer his purposes. Given the purpose for which any new breed may be desired, the type may be fixed with mathematical precision. We then select from the millions of animals before us on the globe, as breeders, those which combine the forms and qualities desired. In breeding we naturally select those individuals which are best suited to our purposes, and when this process has been continued methodically for a length of time, having due regard to the habits and taste of the animal in regard to food, climate, &c., the type becomes fixed, thus perpetuating the survival of the fittest. This process of methodical selection, with a distinct object in view, to make a new strain of blood or breed superior to anything in the country, has been successful in the hands of eminent breeders both in this country and in Europe. It is essential, however, that those who engage in such enterprises should have means to conduct their operations under the most advantageous circumstances. Many striking examples might be noted. We will only mention, however, the improvements which have been made in the weight, early maturity, and fattening qualities of cattle, sheep and hogs during the past half century. Mr. Darwin points out that by a similar process of selection and careful training, the English race-horses have come to surpass in size, fleetness and powers of endurance, the Barbs and Arabs from which they are descended, so that by the regulation of the Goodwood races they are favored in the weights they have to carry. Another excellent illustration of the effects of such a course of selection, which may be considered unconscious in so far as the breeders expected or even desired, was the production of two distinct strains, from two flocks of Leicester sheep which were kept by Mr. Buckley and Mr. Burgess, and were purely bred from the original stock of Mr. Blakewell for upwards of fifty years.

This principle of natural selection and survival of the fittest has been observed to obtain even among the most savage tribes of the human race, as is illustrated by the inhabitants of Terra del Fuego who, in times of great dearth, kill and devour their old women as of less value than their dogs.

As to the breed best suited to the United States, if we recognize the principle of the division of labor as applicable to the brute creation as well as to man, we must select for each specific duty to be performed that horse which is endowed by nature and by breeding with those qualities which are best suited for their purpose. Undoubtedly improvements may be effected in all breeds by the intelligent and judicious application of the principles above enunciated. But that any one variety of the horse species can be made to perform with equal facility the multiform duties required by man, no one will affirm. Nor would it be asserted, under the light of past experience, that any of the various breeds of horses are so well adapted to some of the arduous duties imposed upon them as his hybrid relative, the mule.

THE MULE, HYBRIDS, MONGRELS, ETC.

Permit me to call attention here to those portions of Mr. Darwin's work in which he has discussed the effect of the crossing of two distinct species of the same genus, which results in a hybrid; and likewise the crossing of different varieties of the same species, which leads to the production of mongrels; also the existence and effect of dominant species. Among many other interesting and instructive facts he has pointed out that prepotency, or the power of a parent to transmit its likeness to an offspring,

exists more strongly in one sex than in the other and also in one species than in another. This is demonstrated both when one species is crossed with another and when one variety is crossed with another variety. The mule affords a striking illustration of the existence of this law. It is conceded by naturalists that the ass has a prepotent power over the horse, so that both the mule and the hinny resemble more closely the ass than the horse, but that the prepotency runs more strongly in the male than in the female ass so that the mule, which is the offspring of the male ass and mare, is more like the ass than is the hinny, which is the offspring of the female ass and stallion. Linnæus, in his physiological researches upon this subject, pointed out that, while the mule derived its cortical substance and outward form from the ass, its medullary substance and nervous system were derived from the mare; also that the hinny had more the outward form and structure of the horse, while its medullary substance resembles that of the ass. Buffon also has pointed out that it preserves the diminutive form of the ass, and is therefore smaller than the mule. Pliny also tells that, owing their sloth and the difficulty in managing them, they were not held in much estimation by the Romans, while the mule was no less esteemed than at the present day. Is it not remarkable that in this wide awake and progressive country, more attention has not been paid to the breeding of this invaluable animal?

In conclusion, permit me to urge upon this body the importance of this subject. The mule is equal in antiquity to and more useful than any one breed or hybrid of the equine species, because when properly bred he combines the good qualities of all, and can fill any position with honor to himself and satisfaction to his master. In every age of the world he has borne the burdens of war and reaped the harvest of peace. When we consider his early maturity, his longevity, his economy of keep, his patient submission under the heaviest burdens, his capacity to endure the greatest hardship and the severest toil, disregarding alike the torrid heat of a tropical sun and the wintry blasts of the northern zone, is it assuming too much when we affirm that the "breed, shape, size, and temper of the horse best adapted to the United States *is the mule.*"

Mr. SANDERS, of Illinois. Before any discussion is had upon this paper, if there should be any, I wish merely to state for the information of my associates upon the committee appointed to interview the Committee on Agriculture in the Senate in regard to the Hatch bill, that Mr. Conrad, who is a member of the committee, will visit Senator Mahone, its chairman, to-night and ascertain when he will see us, and we can then arrange for a meeting.

The CHAIRMAN *pro tempore* (Mr. PAGE, of Virginia). The subject of the last paper is open for discussion. [After a pause.] If no one desires to discuss the subject——

Mr. BEVERLY, of Virginia. Before you announce the programme for to-morrow, I will make a motion that if there is no other discussion on meeting to-morrow, this paper be then taken up.

The motion was agreed to; and at 4 o'clock and 20 minutes p. m. the Convention adjourned.

FOURTH DAY.

FRIDAY MORNING, *January* 26, 1883.

The Convention was called to order at 10.30 a. m. by President Loring, who announced the remaining papers, and introduced Professor Peabody, of Illinois, who read the following essay, prepared by Professor Morrow, of the Champaign Industrial University:

BREEDING AND FEEDING FOR BEEF.

By G. E. MORROW, *Professor of Agriculture, Illinois Industrial University.*

Beef production is, and must long continue to be, a leading branch of American agriculture, and beef forms an important part of the food of our already more than 50,000,000 of people, soon to be 100,000,000. In no other country of the world is the

consumption of beef larger per inhabitant. We are exporting large numbers of beef cattle and a vast aggregate of fresh, salted, and canned meat. The United States must necessarily continue to largely export agricultural products for many years, and the quantity is increasing, notwithstanding our rapid advance in population. To help us preserve the fertility of the soil, to gain the advantage which comes from reducing bulk and increasing proportionate value of articles to be transported, it is every way important to develop the export trade of animal products, rather than that of the cereals.

Fortunately, very much of our country is admirably adapted for cattle rearing. The climate is healthful, the soil produces the grasses abundantly, and that most magnificent and valuable of all the cereals, so far as food for domestic animals is concerned—Indian corn. In view of all these circumstances, it is not strange that the great problem before many American farmers is, how to most profitably convert the vegetable products of their farms into beef—how best to "breed and feed for beef."

No single solution of the problem can be pronounced the only correct one, for the widely varying conditions under which it must be worked out, make radically different processes best in different regions. On the plains of the West, Northwest, and Southwest, where vast tracts of grass lands are to be had without price, the mode of feeding and the class of animals produced will greatly differ from those made necessary by the conditions existing in regions of high-priced land.

On low-priced lands, the natural grasses are often and wisely made the exclusive food of the beef-makers. With more advanced agriculture, made necessary by higher priced land, grains supplement the grass, and these may be supplemented by oil-meal, roots, and by carefully constructed shelter and painstaking care.

In New England, as still more in old England, the quantity and quality of the manure made may decide the relative profitableness of different systems of feeding. On the Western prairies the value of the manure may not even be reckoned in the feeder's balance-sheet.

There are, however, some general principles which, perchance, we may be able to grasp. The model which the thoughtful and wise breeder for beef sets before himself is a symmetrical animal of good size, vigorous constitution, excellent digestive and assimilating power, quiet disposition, early maturity; giving the largest attainable percentage of meat of a high quality, the offal and comparatively valueless parts being reduced to the smallest practicable percentage. He sees in his mind's eye—although he may fail to find his ideal in material form—an animal with a long, broad, deep, well-rounded body; top and bottom lines nearly straight; the bony structure everywhere covered with a thick coating of firm, yet yielding flesh, protected by a soft skin of medium thickness, this carrying an abundant coat of soft, bright, waving hair; the carcass supported on short legs, the strength of the bones of which comes from firmness of texture rather than from great size; the head short, broad at the eyes—the fullness, mildness, and beauty of which bring to his mind the phrase "ox-eyed Juno"—the muzzle fine; this head joined to a short neck, fine at throat but gradually swelling until it is lost in the broad, smooth shoulders. Whether this ideal of his fancy have long or short, thick or slender, or no horns, will depend upon his preference for this or that breed, and is a matter of minor importance. This animal he will think of as possessing perfect health and vigor; a quiet, yet reasonably active disposition; the best of appetites and digestion and a ready disposition to carry and accumulate flesh at any age, becoming well matured, at the latest, before it is three years old.

Bearing in mind the rule that great excellence in one point is usually accompanied by comparative weakness in some other, and that this ideal animal must needs be modified by its environment—by the climate, food and protection—the breeder will endeavor to select for his breeding stock animals which as nearly approach the ideal as the conditions of life under which he must place them make advisable. In a vigorous climate, subject to severe storms, hardiness—the ability to withstand cold, drought, excess of rain or snow—must be counted the first requisite, even though it be secured at sacrifice of early maturity. When the pasturage is sparse activity is essential, even though the legs increase in length and muscle be developed rather than fat.

We define a breed as a collection of animals of common origin, possessing distinctive characteristics, which they uniformly transmit to their offspring.

It will be wise, then, to select animals which are well bred, the test and proof being that they not only possess the qualities and adaptation desired, but also inherit these from a line of ancestors possessing them.

Usually "like produces like," "the offspring resembles the parent," but experience abundantly establishes the law that not the immediate but some more remote ancestor may give character to the stock we rear. The best possible security, short of the actual test, that an animal will reproduce its characteristics in its offspring, is that these characteristics are known to have belonged to a long line of ancestors. Individual merit and adaptation to our needs should be the first and most important points in our selection. Next, the character of the ancestors should be considered.

As we go back, each generation becomes less and less important. We need trouble ourselves very little in the endeavor to determine the character of any one of the 1,024 different animals in the tenth generation back, if we know that the bull or cow which we think of buying is good in itself—can see that its parents are equally good, and have credible testimony that their ancestors, for even three or four generations, were of like character.

I believe in the very great value of practical purity of blood. In this I find the best safeguard against disappointments in breeding. I have no sympathy with the egotism which claims that personal inspection of an animal is all that is needed in selecting for breeding purposes. But great harm has been done by sticklers for imaginary and unattainable absolute purity. The general farmer and many of the beef producers underestimate the value of good breeding, but this is partly because of the extravagant claims made by the "purists." A long pedigree, tracing back to famous, remote ancestors, has value if the good qualities which made those ancestors famous have descended to the present time; not otherwise. It is absurd to ask a breeder for beef to reject cattle, however excellent in themselves—however uniform their good quality—because of an unfashionable cross a half-dozen generations back. It is one of the strongest claims to be made for the improved breeds that, by persistent use of males of these breeds, common or inferior stock may be, in a few generations, made equally valuable with the pure bred. The truth of this claim has been proven in thousands of cases. We do what we can to disprove it when we depreciate the value of animals or families because of supposed flaws in their pedigrees a half century back; or when we insist that not even a dozen or a score of crosses by pure-bred sires can so far remove the plebeian stain from the original common cow as to permit her descendants to be worthy of record in the books into which we proudly copy the pedigrees of recently ennobled cattle families fortunate enough no to be American born and bred. The wise breeder for beef will not undervalue pedigree, but he will test its value by the merit of the animals possessing it, rather than by its length or the fame of the animals at its commencement.

To attempt a comparison of the merits of different breeds seems almost presumptuous in view of the opposing claims made by the partisans of each. There may be, however, a method of partially satisfying the especial friends of each of the leading breeds. It cannot be that all are "best" for any one section of country or set of conditions. It cannot be that any one is "best" for all sections or all conditions. Other things equal, the greater the size the better; but a comparatively small animal is to be preferred for rough, hilly, and thin-soiled regions. Valuable as is the union of milk-giving and beef-making for the cattle throughout a large part of our country, this union in any marked degree may be a positive disadvantage where all that is asked of the cow is to rear her calf.

Let us also remember that there are different standards of judgment of beef animals, aside from the question of adaptation to a given region. To the feeder rapid growth, early maturity, large size and attractive appearance are more important than the best possible quality of flesh. The consumer cares little except for the quality and price of the beef. The butcher prefers the animal which will "cut up best." The butcher's choice of a herd may be far from the most profitable animal to the feeder. The breeder who expects to make grass the chief food of his cattle will much more highly prize good grazing qualities than will he who makes corn the chief fattening food.

The special dairy breeds are hardly in competition in this class. The Channel Island breeds and the Ayrshire, although they produce beef of very fair quality, are too small to meet with general favor, and their friends are usually content to vest their claims on special dairy merits. The Red Polled Norfolk and Suffolk have more claim to good rank, but are not yet widely tested in this country. They are deservedly growing in favor. The Dutch cattle, probably unsurpassed for large flow of milk, and of good size, have neither the form nor the aptitude to lay on flesh that entitle them to more than a medium rank. The Devon, one of the most beautiful of all breeds, hardy, active, a good feeder, with flesh almost of the very finest, has never been generally popular in the great beef-producing regions. The small size has overbalanced all good qualities. No breed has more enthusiastic friends, but its field is a limited one. On the plains its hardiness has won favor with some.

Few breeds have grown in favor more rapidly than has the Hereford in recent years. Early introduced into the country, the cattle of this fine breed made little progress till within a dozen years. Now they are highly prized and highly priced. Imported in large numbers, owned, exhibited and admired by gentlemen of wealth, intelligence and good judgment, they are rapidly increasing in number and being introduced into many parts of the country. They are almost of the largest size, very hardy, with deep, well-rounded bodies on short legs; among the very best grazers, and fattening into well-proportioned carcasses of excellent beef. They are not good milkers, as a class; their horns are a trifle heavy, and often they deserve the criticism of being light in the hind-quarters, although their unusual development of the fore-quarters

sometimes makes this comparative rather than actual. For the plains and for those who make beef production, the only use to which cattle are put, the Herefords have much value. They are not so well adapted for that very large class which attaches importance to milk production as well as beef-making.

The black polled Scotch breeds—especially the Aberdeen-Angus—have grown in public favor with really marvelous rapidity. The Galloways have been bred in this country (in small numbers) for twenty years or more, but attracted little attention until the success of the Aberdeens at Paris in 1878 and at other exhibitions. Of the two breeds the Galloway is the coaser, probably the hardier, as it has been less artifically handled. No admirer of fine beef cattle can fail to be well pleased with the better specimens of either breed. The black color has not been fashionable in the United States, but this is only a matter of fancy. The lack of horns is a point in favor of these breeds, although its importance has been ludicrously overstated. Much more important are the compact, symmetrical, broad-backed, round bodies, the aptitude to lay on flesh, the high quality of the flesh, and the hardiness of the cattle. So far as tested in the Northwest, they have given good satisfaction. I count their future popularity assured, both as pure breeds and in crosses with either the common cattle of the country or with Short-horns. No small share of the reputation of these cattle has been won by the exhibition of animals produced by crossing Scotch cows with Short-horn bulls. These breeds are not good milkers as a rule.

The Short-horn retains its position as the most numerous, most widely distributed and popular breed of improved cattle. Other breeds have grown in favor, and this has seemed to be losing favor. But there are more of the breed, and it has more friends than ever before. Its long-continued, remarkable popularity wrought evil as well as good. No other improved breed has suffered so much from following "fashion" by breeders. The great demand has caused the use of many animals for breeding purposes which should have gone to the shambles. Unreasonable prejudice in favor of certain lines of pedigrees and against others, in favor of the formerly extremely rare red color, and against the once common roan and spotted color, have done harm. Many breeders have done what they could to destroy the milking quality of the cows. The breed has not the great hardiness of some of its rivals. Its beef is not of the very highest quality.

Admitting all this, "the red, white, and roan" still stands at the head of the list of breeds for beef production in America. I would not select Short-horns for a farm in the Gulf States; nor for one in the extreme northern line of the country; certainly not for a cattle ranch in Montana. Possibly those farmers of the Western States who make a specialty of beef-production may do wisely to select another breed, although of this I am not sure. But the merit which has enabled this breed to become by far the most cosmopolitan of all the cattle kind—to spread from its original home in Northeastern England over much of England, Scotland, Ireland, America, Australia, and even on the continent of Europe—has not been lost. Its highest type is, to me, the highest type of a beef animal, and it is by far the best exemplar of the possibility of combining in one breed fair excellence in beef-making and milk-production; while no other breed has yet proven itself so successful in improving other and inferior breeds when crossed on them. Of the first rank in size and early maturity, of quiet disposition, fattening readily, with care in selection and management, above the average in milk-giving, the Short-horn more nearly meets the wants of the average good farmer on rich soils than does any other. Its breeders need to look more closely to individual merit and less to pedigree than some of them have done; to guard against weakness of constitution: to breed from animals as good in front as behind, and, often, to reduce length of the leg.

Sneered at as the phrase is, the words "general-purpose cow" describe the cow best adapted to the wants of the largest number of American farmers. The number of exclusive dairy men will probably increase; the demand for the especial dairy breeds will continue and increase. But over a steadily widening area, land is becoming too valuable to make it profitable to keep cows for no other purpose than to rear their calves, yet where dairying cannot well be given a chief place. The most widely popular cow of the future will give satisfaction at the pail and at the butcher's block.

It is rarely advisable to purchase a herd of pure-bred cows from which to rear steers, as the demand for them keeps the price at comparatively high figures. Fortunately, it is not necessary to do so in order to be fully successful. Continued use of well-bred and wisely-selected sires will, in a dozen years, give animals practically equal to the pure-bred stock. Over much of the country, the much-derided "common stock" furnishes a capital foundation for a herd of good beef-producers; and in many sections good cross-bred or "grade" cows can be secured.

The choice of the best attainable cows adapted to his purpose; the use of good pure-bred sires of any good breed; persistent rejection of inferior animals; breeding, so far as is possible, only from well-matured animals in good health, will give a farmer the reputation of being a good breeder; provided, always, he acts equally wisely in his feeding. There are animals and breeds so poor that no skill in feeding and man-

agement can make them give satisfactory results; but there is no breed so perfect that it may not be injured or ruined by poor feeding and care.

That remarkably successful producer of high-class beef cattle, J. D. Gillett, of Illinois, once summarized the art of producing the best fat cattle in these words: "Get good steers and give them plenty to eat." Assuming that we know how to select a good steer and how to select its food, this advice may be said to cover the whole ground. But the economy of different modes of producing fat cattle is yearly becoming a more practically important question to American farmers. The possibility of production needs to be discussed much less than the economy.

The best school for the study of results of different systems of feeding and management of beef cattle to be found in America, is the annual fat-stock show in Chicago. No point has been more clearly demonstrated than that it is possible to produce animals nearly approaching the highest standard, not only by selections from different breeds, but by any one of three or four widely divergent systems of feeding.

Steers not yet two years old, yet thoroughly ripe and weighing 1,600 pounds or more; two-year-old steers, weighing from 1,800 to 2,200 pounds, and as thoroughly ripe and matured as need be; a very few steers weighing from 2,800 to 3,150 pounds, showing the possibility but exceeding difficulty of producing really good steers of such great weights—cattle fattened with the careful housing, blanketing, grooming, and feeding of ground food, roots, &c., which has been made a life-long study by breeders and exhibitors; cattle reared and fattened in the open air, with no shelter, no grooming nor blanketing, and no food save the mother's milk, grass, and Indian corn on the ear—all these have been shown. And it is noteworthy that the highest prizes have frequently been awarded cattle not of the largest size, and to those produced under most simple systems, where an abundance of food and almost a minimum of care had been given.

It is no disparagement to the value of these exhibitions nor to the skill of the exhibitors to say that many of the finest-appearing animals had not been economically produced. Except for exceptional markets, most of them were overly fat for greatest profit to butcher or satisfaction to the consumer, while some of them had cost more than they could be sold for in ordinary markets.

We must accept the fact that the mass of our people will, perforce, be compelled and content to eat beef not of the highest quality, and that cheapness will be an essential to the largest consumption. Even for the export trade the best demand is not for the largest animals. Good fat steers of 1,400 to 1,600 pounds are in much more general demand than those 400 pounds heavier.

The great cattle ranches of the West and Northwest are not only sending increasing numbers of cattle to our eastern markets, but cattle of a steadily-improving quality. I do not count this a permanent system of beef production, but for some years the feeders of the Central and Eastern States must meet competition from those who rear fairly good cattle on grass alone.

Those who produce high-class beef will not so directly feel this competition, but even for them economy of time and food is made more important by it.

The skill of the breeder has not been more strikingly shown in molding the form of his cattle than in securing early maturity. It has been proved that it is possible to produce well-matured beeves of great size at a very early age. We have not yet reached the time when the sale of "baby-beef"—steers eighteen to twenty-two months old—will generally be advisable; but over much of the great beef-producing regions three years ought to be the maximum age for most of the fat cattle.

"Continuous growth from birth," "never losing the 'calf fat,'" "never letting the young animals feel the want of food," are maxims essential to securing the highest type of excellence. No food for the calf is equal to its mother's milk, supplemented as early as practicable with bran, meal, &c. Allowing the calf to suckle its dam is also the best and only mode for chief production on the Western plains. For tens of thousands of farmers, however, this mode is too costly. On high-priced land it is poor economy to keep a cow and have no other return than a calf each year. Milk substitutes have been devised which answer moderately well. It is not certain they can be profitably used in this country as yet. But the experience of many—our own among the number—shows that good results can be obtained by feeding sweet, skimmed milk, substituting for the animal fat, oil-meal mixed with bran, oat or corn meal, &c. We have found good results from combining the rearing of calves with winter-butter dairying, allowing calves to go on grass in the spring strong, thrifty, and fitted for rapid growth.

For most of us, grain feeding to young animals on the pastures is not profitable as yet. For many, full feeding during the first winter does not give a profit; but to allow the young animals to lose in winter what they have gained in summer cannot be wise.

Grass in the fields is yet the chief food from which to secure growth in our cattle, and while the flax-seed of the North and the cotton-seed of the South give us exceedingly valuable foods, destined to be used more and more; while the preservation of

green fodders in silos has been shown to be practicable, sometimes profitable, Indian corn remains the one great food for fattening our beef cattle. A large majority of the better beeves of the country have this as almost exclusive grain food, fed in the simplest way, unground, unshelled, often unhusked. "A wasteful way!" Yes. "Not the best food for securing largest results!" True; but in existing conditions this primitive system is often the most profitable. As lands and corn advance in price, grinding the grain, mixing with it bran or oats, possibly the use of roots, becomes advisable.

This is written with the thermometer well below zero. At such a time arguments in favor of good shelter for cattle have most force. With "20-cent corn," Western beef-makers have insisted that feed is cheaper than stables. To-day, on Mr. Gillett's farms, cattle which next fall will possibly repeat the prize-winning of these herds at the fat-stock show, are standing without other shelter than stalk fields or groves of trees. Liberal stall-feeding has not yet become profitable in the farther West, perhaps not generally so in the central West. Shelter by tight yards and good sheds already pays; warm stables will come in good time.

Adaptation to the conditions in which one finds himself is the secret of success in farming; and in our new country the greater part of our beef cattle is produced in regions in which comparatively simple, and apparently wasteful methods have been indicated.

There is always a danger that farmers, with the conservatism natural to the class, will be overly slow in changing systems to meet the rapid change of conditions which the marvelous growth of our country brings. All honor to the progressive farmers who lead in showing examples of the more advanced systems!

To-day, however, the greatest danger of loss to our beef-producers and dairymen is not that they select breeds or individuals unwisely; not that they do not feed skillfully—there is vast room for improvement in these points, and slowly that improvement comes. We can afford to wait for it. But there is a vastly greater danger to all this interest in the existence in our country of contagious disease among cattle, which is a daily menace to the health of the herds of the great beef-producing States, and which has already partially cut off a great market for our fat cattle. We cannot afford to wait and hope for gradual improvement in this matter. There are evils which can gradually be removed. There are others which must be crushed out. Pleuro-pneumonia is of the latter class.

Aside from this as yet unappreciated danger, the great industry of breeding and feeding for beef is in a healthful and flourishing condition, conducted, in the main, by men of intelligence, energy and shrewd common sense.

The PRESIDENT. If gentlemen, who no doubt are very anxious to take up some points for discussion in the admirable paper just presented, will be kind enough to withhold and remember the remarks they were about to make until Colonel Scott, of Iowa, reads a paper alluding to breeding and feeding for beef, then we shall be glad to have a general discussion for a short time on these papers.

Colonel John Scott, of Iowa, will now read his paper.

Colonel SCOTT. It is perhaps a fortunate thing, Mr. President, since you are called upon to listen to a paper that only debates briefly some of the elementary principles involved in the discussion, that such an exhaustive paper precedes it. It is interesting to me to discover that, in the preparation of papers under the same request, and at some distance from each other, we do not repeat everything just in the same way.

BREEDING AND FEEDING FOR BEEF AND SUPPLYING THE MARKET.

By Col. JOHN SCOTT, *of Iowa.*

The subject assigned me is of great importance to all the civilized people of the world, involving nothing less than the supply of a large and most valuable portion of their food. In its economic relations it is of intense interest to both producer and consumer, and presents many problems worthy of the best thought of the political ecomomist and the statesman. I enter upon the discussion of it before this Convention in the expectation that what is here presented may open the way for the many valuable facts in your possession. A brief paper upon so broad a subject must of necessity be suggestive rather than exhaustive.

What is beef? It is in general the flesh of animals belonging to the genus *Bos,* more

especially to the species *Bos taurus*, and in this connection may be limited to the flesh of our domestic cattle.

Defining "beef," the lexicon says, "The flesh of bovine animals, when killed." The term includes all fleshy parts of such animals, ranging from that of the ancient dame or patriarch of the Texan plains, which by means of the lasso and the knife, at the end of a hot race for life, may be cast upon smouldering buffalo chips as a burnt offering to the keen appetite of the festive cowboy, as well as the choicest morsels of tender, juicy, marbled cuts, that recently weighted the hospitable board at the White House, feeding the discriminating appetite of the chief Executive, and which came from the famous "Crimson herd" that was prepared for bovine glory by a plentiful use of corn and grass grown on Iowa soil.

QUALITY IN BEEF.

This proposition is worthy of consideration in greater detail. The difference in quality of the flesh of animals of the same species is actual, not speculative, and has been determined by most careful investigation. Cuts have been made from identical portions of different carcasses, and these have been tested by experts. These have been examined under the magnifying lens, and the form and substance of the different tissues have been accurately estimated. They have been submitted to various satisfactory tests, and the causes of their differences in desirability and value have been ascertained. It has been found that the flesh or muscle of certain beef animals, under favorable circumstances, has what is called a "marbled" appearance. This is caused by the distribution of minute portions of adipose matter, or fat among the fibers of the muscles, filling the vesicles of the cellular tissue which are distributed throughout the muscular portions of the animal. The absence of this quality is noted in the flesh of wild animals that lead an active life, and especially those which depend for safety upon their fleetness, such as the deer and antelope. It is found in greater degree in the muscles of the cart-horse than in those of the thoroughbred, and for obvious reasons. Similar variations are observed in the flesh of the domestic bovine, produced by habits of life continued through many generations, as in the wild cattle of the Southwest, or by scant supply of proper foods, whether in scant pasturage in summer, or from deficient forage and shelter in the colder winters of the north. On the contrary, and most fortunately, although it may be more difficult to maintain and perpetuate the better qualities of animals, it is possible to establish in individuals and in families, vigorous digestive and assimilating capacity. Through this, and the maintaining of such a state of rest as may be consistent with a high condition of health and vigor, and by a plentiful supply of nutritious food, supplemented by proper shelter, it has been proven that individual animals may have their flesh greatly improved in quality, and by long continuance the type may be so fixed that it may be perpetuated through procreation.

TESTING QUALITY.

The extent to which these variations in quality obtain, is not appreciated by the great masses of mankind. The wonder that this should be so, ceases when we remember that the lean kine of the earth are numbered by millions, while those of the finest quality are still in most scant supply. It is safe to say that many millions of well-fed Americans are strangers to the taste of beef of the best quality, and are utterly indifferent or even incredulous as to the facts. Their importance will justify brief quotations from a report made by Dr. George Sprague, at one time president of the Iowa Improved Stock Breeders' Association, made at the request of the Illinois State Board of Agriculture. His investigation included the microscopical examination of samples of meat from cattle that were slaughtered in competition for the prizes offered at the national fat-stock show, and were among the best the world has ever produced. He also extended his researches to other and inferior samples, and also tested them by partial drying and by cooking. He says: "The specimens examined under the microscope, and tested by cooking, were taken from the loins of Shorthorn and Hereford grades, slaughtered in competition. A careful examination in every state from moisture to extreme dryness, running through a period of ten days, shows no discernible difference in color, structure of fiber, or the equtable distribution of fat vesicle and fat among the muscular fibers of these steers. After thoroughly weighing and sifting every feature of the structure or fiber and fat in the representative specimens of the two breeds, I conclude that superiority must determine by early maturity—gain upon a given amount of feed, weight of offal, relative amouts of best and poorest parts, and by the test of public taste based upon exterior form and finish.

"Specimens were also procured from the same parts of the carcasses of low grade steers and those known as scalawags. A comparison of this with that of the high,

prompts me to ever hereafter refuse to take upon my plate a cut from the class referred to. The lean fibers of such meat are like India rubber, and are held together by a glutinous substance and not by cellular tissue and fat vesicles, filled with fat and easily separated, as in the case of the high-bred cattle. The specimens of the meat of low grade began to curl as soon as the drying process commenced, and in three days the edges were curled and thoroughly dry; whereas the cut from the high grades remained moist and flat upon the paper, though they were cut four days before the others were procured. When dry the cuts of the scrub meat would break before they would bend, and when crooked were without fat, juiciness, or flavor, while those from the high grades maintained all these qualities after having been for a full week exposed to the air."

A practical test by cooking from all the samples was also made, and the deductions from this were in full corroboration of the previously ascertained fact that the better bred and better fed cattle are the only ones that furnish meat fit for the table of an American citizen who realizes and respects his high privileges.

BREEDING AND FEEDING.

It is within the scope of the subject assigned me to inquire to what extent the condition above described may be influenced by breeding and feeding. It is not to be doubted that these two great influences are intimately related in producing the various results that are possible in pursuing this most interesting industry. To tell first where either one may be supplemented by the other, or where the influence of one ends and that of the other begins, may not always be possible; but that they do supplement each other, and that neither can stand alone, is without reasonable question.

It may be conceded that the fats which find their way in the nutrition of the animal to their proper home in its economy, to the vesicles in the cellular tissue, have their source in the food consumed. If the food is not rich in fat elements, it matters not how perfect soever the animal's powers of digestion and assimilation may be; it cannot deposit fat, neither between the muscles nor among their fibers, nor elsewhere. Such foods, then, are seen to be essential, not alone in quality, but also in quantity. They must be had in abundance, and without such labor as will exhaust them in the production of the power that shall sustain active and long-continued locomotion. A plentiful supply of corn and nutritious grasses, or, in the absence of the grasses, supplementing the corn with rough forage and a ration of linseed or cotton-seed meal, has usually been found sufficient. But with all of these, and a state of rest in luxurious stalls, if the fat vesicles are scant in any beast the deposit of fat will be in the same proportion. That the fat vesicles are scant in the native Texan and in the northern scrub needs no proof; that they are more abundant and more fully distributed in the better parts of high-bred cattle is equally certain.

Thus we see that in the low-bred and scantily-fed cattle a condition of the system is found which, under high feeding, deposits fat in large quantities immediately under the hide, about the kidneys and on the intestines. Such fat, in our climate, is rarely used as food, at least in its primary form. It does not cut into prime steaks, such as an American will use.

PREPOTENCY IN BLOOD.

But the experience of all ages gives us the maxim in procreation that "like begets like." This proposition must be understood to mean that the parent transmits its individual qualities and those which it inherits. Some of the latter may not be conspicuous, yet they are parcel of its existence. Stated more in detail the maxim would read: Every parent transmits those qualities possessed by himself or by his ancestors. In accord with this rule we should observe that individual animals, men included, are born with fat vesicles in more or less abundant or scant supply, as certainly as they are born with a certain color, complexion, or contour, which they, without doubt, take by inheritance.

If the above premises are correct, it follows that in breeding for beef we must look well to the qualities possessed by the parent. And this leads us to consider the relative importance of the dam and sire. The great English auctioneer, John Thornton, is credited with saying that "the bull is half the herd." He made this remark in connection with the rearing of thoroughbred cattle, where the dams are, of necessity, purely bred and of great value. It may not be successfully controverted, but if true in such a case, how much more true is it in the herd of him who is breeding for the butcher's block? In such a case advantage may be taken of the opportunity to supply low-priced dams, which may be readily had in large numbers. If these are coupled with a strong-bred sire we get the advantage of his prepotence over the dam by which, n many cases, an inheritance of quality is obtained from the first cross, which greatlyi astonishes many a young breeder. In this way the foundation for a good herd of beef

cattle is laid without loss of time. The steers of the first cross will be of quality that will reach the market, if in prime condition as to flesh, rating well towards the top. The cow-calves of such a herd will soon be ready for a second and third cross of the same quality, and will be the dams of bullocks that will rank as export cattle. The owner of a herd with such a foundation is fully prepared to breed for beef. [I assume that the sires selected are of the beef-producing breed.] If the breeder is so situated that he cares only for beef, and gives no thought to the usefulness of his cattle for other purposes, ignoring the dairy, he may safely select blood with sole reference to the beef product. But fortunately, there are races of cattle not excelled for the production of beef and also of great value in the dairy. Due reference to economy might suggest the wisdom of rearing from such stock males for the shambles and females that would be in demand for the dairy as well. In such a case the breeder has his option.

SUPPLY AND DEMAND.

And here it may be well to note that the cattle of America are mostly in the hands of small farmers. We read of a few scores of persons who have vast herds of cattle, most of which are on the arid and unfenced regions of the far West that lie beyond the Missouri River. The operations of these persons are upon a scale that attracts much attention, and we contemplate them with a sense of bewilderment; but the census shows that the small farmers of Iowa or Illinois hold cattle greatly exceeding in numbers the grand total of those held by the so-called "cattle-kings" of the plains, and of a quality and value in still greater excess. Is it not, then, upon the rich pastures of the small farmers and in their barns, that the choice beef of the world is to be mainly grazed and fed? And it is cheering to know that the farmer of to-day is advancing to a knowledge of the principles here set forth; that he is learning to follow the get of good bulls as they go to the butcher's block, and to inquire why they bring increased money to the purses of the breeders and feeders of such cattle. He will discover in time that there is rare quality in the product, as well as economical production of quantity; that the sense of taste as well as those of sight and touch may well be consulted, and that to do this brings added shekels to the income and increased comfort to the home. God speed the day when he shall be enabled to see these things not as through a glass darkly, but in the clear sunlight of heaven. When this consummation shall have been reached, the words of John Thornton will blaze before him—"The bull is half the herd!" The principle involved in this terse sentence applies with equal force to all kinds of stock.

But it may be added in parenthesis that there are yet millions of American farmers living in close proximity to the ubiquitous school-house of the Northwest, who have less fear of the wiles of the book agent, the lightning rod vender and the patent fiend, than they have of the poverty that would strike them through the use of thoroughbred blood that must be bought.

To such an extent does this sentiment prevail, that those upon the upper rounds of the ladder of improvement need have no fears of being crowded, nor of such an overproduction of goods of the best quality as will glut the market.

NO SURPLUS OF THE BEST.

In illustration of the vanity of this fear the facts in relation to the production of choice butter may be cited. The date is within the recollection of all present when the amount of gilt-edged butter in America was not 1 per cent. of the present annual and rapidly increasing product, yet to such an extent is a more discriminating taste demanding the better quality, that the supply is always short and the price correspondingly remunerative to intelligent dairymen.

And in spite of the incalculable capacity of this country in the production of choice beef and choice butter, the two items of our daily food that can only attain perfection in the hands of highly intelligent and thoughtful producers, such is the rapidity with which their appreciation is extending, under the present progress of the world, that the market is much more likely to advance indefinitely than to decline.

FEEDING FOR BEEF.

As the choice beef cattle of the world may only be bred and reared where the master may care for and control individual animals, rather than by those who can only look after them as herds, so also does this principle apply in economical feeding.

Some of the elementary principles involved in the science of nutrition, on a due observance of which depends healthful increase of the herd as well as growth and constitution of the individuals which compose it, may be stated:

The lessons of the chemical laboratory, the experiment station and the feed lot, all

teach that feeding an animal does not mean casting before it certain amounts of grain and coarse fodder.

Reason alone should teach us that to build up the animal frame and sustain its waste, the elements that enter into its composition and those which are consumed in supporting the combustion that is essential to living existence, must be used in due proportions. It is known that certain elements are consumed in large quantities as food, a very great percentage of which goes simply to sustain animal heat and animal waste. They serve as fuel to the living engine as completely as coal serves the purpose of the locomotive, and are as completely exhausted and changed to force, smoke, ashes and vapor in one case as in the other. In each case a certain amount of this fuel, and not a small amount either, is consumed as the fuel or food of support. It simply keeps the machine alive and ready to exhibit force when more fuel is applied, or growth in answer to more food. This added food, as applied to growing animals, is that in which all the profit lies. It is called the food of production. The other and larger quantity is called the food of support.

The importance of using such foods as contain all the necessary elements of nutrition and in due proportion, may be illustrated by simple, yet conclusive experiment. The experiments, numerous and exhaustive, that have been made at the German stations, prove that the proportion of carbohydrates to be allowed in the food of grown domestic cattle, to give perfect nutrition, is that of twenty-seven to five, or nearly five and one-half to one. But if the one be wholly removed, the other five and one-half will not sustain life. Starch forms a large portion of our Indian corn; yet, confine two mice, give one of them only all the pure starch it will eat, and give the other only water, and they will both, with equal certainty, starve to death, and in nearly the same time. Boil lean meat slowly, in water heated gradually, until the albuminoids have been fully extracted, cast away the liquid, and all the remainder that a dog may eat will not prevent his starvation.

PALATABLENESS.

Again, place unpalatable food before such fastidious persons as compose this audience, or place even palatable food before them under circumstances that prevent its enjoyment, and the analysis of the chemist will give no idea of its nutritive value. All experience teaches that domestic animals have likes and dislikes that correspond in some measure with human tastes; therefore, palatableness is an important element in the study of nutrition.

But, among the most important matters for the consideration of him that would produce beef of superlative excellence, is the essential fact that animals for this purpose should never be permitted to lose the elastic condition of muscle and hide with which a calf of a healthy and thrifty sire and dam is born. It is said that a shrunken muscle can never be fully restored; that if the fat vesicles disappear, the quality of the animal is to a certain extent lost and can never be regained. Such an animal, one that has come through a northern winter with the straw stack for food and a barbed wire fence on the south for shelter, or a calf that has been "knocked on the head with a churn-dash," can never come to the block as an animal of prime quality.

Indeed, the only safe rule in this respect is that followed by the Hon. D. M. Moninger in the growth of the famous Crimson herd, "never, through all their lives, to let them go to bed hungry."

A study of the principles herein so briefly discussed, goes far towards proving that the live-stock industry of America is worthy the attention of the scientist as well as of the peasant, and that the patriot and the philosopher may discover herein paths that lead through the widest ranges of human thought. He that would benefit mankind in the present and be a benefactor of posterity, finds here a field in which his grandest energies may be usefully displayed, and in which he may earn (though possibly not receive) the benediction from ages to come, "Well done, good and faithful servant."

Mr. SANDERS, of Illinois. I am very sorry that I did not arrive in time to hear all of Colonel Scott's very able paper upon this subject. But there is one thing alluded to, which I wish to bring to the attention of this Convention lest it may mislead, to some extent, the conclusions drawn from the analysis and examination or experiments on the meat of Dr. Sprague, at the Chicago fat stock show, in presenting what were the qualities of scrub meat. While the conclusions drawn from their experience by Dr. Sprague and Colonel Scott are extremely gratifying and encouraging to the breeder of improved blood and the highest classes of stock, yet it must not be assumed that these experiments establish those facts by any means. It must not be assumed, either, that they

even tend to establish those facts. The point to which I allude is this: The meat of the high grades or of the thoroughbred animals was intrinsically of greatly superior quality to those of the so-called scrub cattle. All that was known of those experiments was that the meat which, in the hands of Dr. Sprague, showed the best quality was from animals entitled to be classed as first-class beef animals. They were well fed and in excellent shape. Some were from animals exhibited at the fat stock show; others were from the stalls of the best butchers of Chicago, establishments where the best qualities of meats were to be procured. As a matter of fact, they did not know whether this meat was from Texas steers or from buffalo or scrub steers. They only knew they were fat and from first-class bullocks. And again, in the analysis, examination or experiments with beef taken from the Jackson street markets, all Dr. Sprague knew was that it was scrub beef. He simply knew that the animals, as they came into the market, were so poorly fed that their beef would not bring a first-class price, and they were put in the lowest class of butcher's shops and sold as cheap meat. Now, while perhaps it is not probable, yet it is altogether possible, that this very meat which Dr. Sprague analyzed or examined and called scrub meat, was from three-quarters to seven-eighths Short-horn, and brought into the market very thin and in a miserably poor condition. That is all known about the amimals which were the subject of these experiments. I witnessed Dr. Sprague's experiments from beginning to end, and I called his attention to these facts when they were in progress. I told him that he was misleading the public by assuming as a matter of fact that which was not known to be the case. Still, I believe generally that Short-horns and Herefords will make better beef than some other breeds of cattle, and under even precisely the same conditions. It is a pretty well established fact, Mr. President, that the methods of treating from calfhood up to beef, in which the animals are kept up to the time of slaughtering, and the condition of ripeness at the time of slaughtering, have very much to do with the quality of the beef and the marbled appearance of it, and while I would not assert that the meat of the Hereford or the Short-horn, or the meat of the Ayrshire or of the Devon is better than that of the scalawag, as we call it, at any rate I do say that these experiments prove neither one thing nor the other on that point. They did not pretend to show what the blood of that scalawag was. They only showed that it was from what is called scalawag beef in the Chicago markets, and that simply means an animal brought to market in a poor condition.

The PRESIDENT *pro tempore* (Mr. COFFIN). If it will not be out of place for me to suggest a thought here, I will do it. It happened one time that I hit upon this method of illustrating the value of incorporating good blood in our herds. The point I make is, that we wish to convince the average general farmer that he can get a great many more pounds of meat from the same character and quantity of food by using good sires than by using the native scrub. I illustrated it in this way: If we should take two kernels of corn and plant them right here in this soil, one kernel coming from rocky New Hampshire and the other from down South or from the West, they will grow every day, getting exactly the same kind of nourishment. The one grows up, towering largely, with abundant foliage, while the other grows like the Yankee corn; and change your food and do what you will, that same difference nevertheless exists. One has the capacity, so to speak, to assimilate or use all the food, and hence produces the greater growth.

The Short-horn, for instance, has the ability, under some circumstances, to produce greater growth and gives us more pounds of beef.

Now, just another point in relation to what Mr. Sanders suggests. I think Dr. Sprague himself, in a late article in the Live Stock Journal, has recanted his own theory.

Is it not the experience of every one of us small practical farmers, when we take a cow that has failed of her usefulness in the dairy, and having put her rapidly into beef condition, that we have generally about as good beef as we ever get? Is not that the case with the practical, every-day, small farmer? While we do not wish to say a word that will defend the neglect of animals or encourage the slack kind of farming which lets the young animals lose their calf-shelter, still the fact stares us in the face that when muscles which have been all shrunken up are replaced, we do get a fine quality of beef, and sometimes the very finest quality of marbled beef.

Mr. SANDERS, of Illinois. I merely rise to call the attention of the convention to the fact that on yesterday, without giving any thought to its many obligations, I allowed myself to be named as chairman of a committee to wait on the committee of the Senate, under a resolution which I offered. I now wish to state that my outside duties in connection with the Treasury Cattle Commission will make it almost impossible for me to give any time to this business. I ask, therefore, that I be relieved from duty on that committee, and that some one else be appointed. I suggest that General Curtis has a large acquaintance, is a "prince of good fellows," and able to talk all around an ordinary mortal. [Laughter.]

General N. M. CURTIS, of New York. I do not know how much time Mr. Sanders can give to this work, but I have no doubt he will give all he is able. As for myself, I do not need any authority nor any appointment upon a committee to induce me to see the officials connected with this legislation, and I therefore hope the chair will not put me on the committee.

The CHAIRMAN *pro tempore* (Mr. COFFIN). The remarks made by Mr. Sanders will be taken into consideration. I will consult with Commissioner Loring, who appointed that committee.

Professor KNAPP, of Iowa. I would like to call attention to one point, and I simply name it, hoping that some one else will discuss it more elaborately. It seems to me it ought not to go out to the people as in any way the verdict of this Convention that common cattle, fattened in the best way that is known, or prepared for the market by the most experienced feeder, can equal the best Short-horn cattle prepared with equal skill and placed upon the market with equal care. Such conviction would defy all the laws of heredity. I am not one of those, as you may remember from yesterday's remarks, who have such reverence for the Short-horns as to feel like taking off my hat and exposing my bald head to the northern blasts out of respect for them; but after all, when they have been fed for beef, they produce beef of a superior quality. Now, if there be anything in heredity, there certainly must be a tendency to implant in the offspring all those peculiar characteristics of muscle and powers for that assimilation and storage of food which produce the best classes of beef. While I can see that the animal which fattens rapidly, owing to new muscle, may make tender beef and of high quality, I am not prepared, by reason of observation, by reason of experiment and by reason of theory, to admit that such beef can in any respect compare with that high quality produced from our choice Short-horn animals. I do not believe there is the tenderness of muscle and the peculiar flavor, and I doubt whether that kind of beef could be placed upon the tables of our best hotels and accepted as first quality

beef. It seems to me that such an admission would destroy all our theories of breeding.

Mr. BAKER, of Ohio. I do not think I have heard anything said here that will be construed by the public to mean that the Short-horn beef is superior to any other, as the last speaker seemed to indicate. This may not have been said; but while I am a Short-horn advocate to the backbone, I believe the Hereford, or any of the Scotch cattle beef, would be as good, and it may be in many cases better than the Short-horn. Nothing has been said here against the usefulness of the half-blood beef. There is a good deal of good beef, not from scalawags, but good common cattle; of course, they would never make fine marbled beef, and I am convinced I could tell that it was cow-beef.

Colonel SCOTT. I take it as quite a compliment to one of the suggestions made in my paper, to the effect that there are many millions of Americans who do not know the taste of first-class beef, that there are gentlemen in this Convention who coincide with me in that opinion.

Mr. HOWLAND. I agree with the remarks made by Mr. Sanders, that in the scientific investigation of these things we want conclusions known to be accurate and satisfactory, and which cannot be gainsayed. Now, in regard to the experiments made, not knowing what breed of cattle nor what kind of beef such experiments were made with, we lose all the benefit of investigation. We wish to know how to get the greatest and best amount of food from the same expenditure of material. I think the remarks made are quite in accord with the experiment in relation to small growth of vegetation, for I have made some experiments in relation to Northern corn and large Southern corn. From these experiments I find we can get a greater amount of corn and food material with the same expenditure from the smaller than from the larger corn.

It takes a greater amount of food to supply Southern corn of the large stem than the small Northern stalk and corn; and by weighing the corn and the corn-stalks from the small corn and the corn and stalks from the Southern corn, I found I obtained a greater amount of corn with the weight of stalks from the small corn than from the large corn. Consequently there was a loss in the stalks, and the material that went to growth was a loss because we did not utilize stalks. We might utilize stalks in the small better than in the large corn, because it is material that cattle shall eat the best, so that, as I say, in all these scientific experiments, the average experiment is not made in such an accurate manner that the conclusions arrived at cannot be gainsayed.

General CURTIS, of New York. Will the gentleman allow me to ask in what locality he made his experiments?

Mr. HOWLAND. My experiments were made on a portion of the Mount Vernon property.

General CURTIS. Will the gentleman please tell the yield of small corn to the acre?

Mr. HOWLAND. I would say, that in the experiments I made I did not keep a record of that, nor anything in regard to it. They were not undertaken for publication. I have made a great variety of experiments, however, in relation to corn and other things for my own gratification simply. Consequently, I kept no record.

General CURTIS. Will he give us an estimate?

Mr. HOWLAND. As near as I can judge, the amount of Southern corn per acre was 60 bushels, and of Northern corn 40 bushels.

General CURTIS. I want to say that I live perhaps as far north as any gentleman here, and the truth is I live in the second town south of the North Pole. [Laughter.] It is the literal truth, as gentlemen will under-

stand, when I state that a line drawn from New York City to the North Pole passes through Ogdensburg and Ottawa, Canada, Ottawa being nearest the pole and Ogdensburg next. I believe Dr. Howland or any other person who shall make the attempt fairly with the larger and the smaller kinds of corn, will find, even in that high latitude, or a higher still, that the production of the larger kind of corn will greatly exceed the possibilities of the small corn. He is giving, I believe, in his answer, the maximum yield of this small corn which it is possible, under ordinary circumstances, to get from well-cultivated lands. You cultivate the lands better and you may get very thin corn, but increased growth, but not to compare with the Southern corn as a profitable crop. I have tested that on my own farm, and I know it to be true of these different kinds of corn. The capacity of this small corn is limited to an amount not profitable to grow on any soil with which I am acquainted.

Mr. HOWLAND. If General Curtis's remarks are true, there must be a great many farmers in this country raising corn at a loss if the Northern corn is not profitable, because we know that there are millions of bushels raised all through our country and raised year after year. It must be a good deal like the man who remarked that it did not pay to raise corn, but we must raise it, because we are obliged to have it.

Mr. F. D. CURTIS. My interpretation of General Curtis's remarks was that for purposes of fodder, the yield of larger corn would be much greater than that of smaller corn. I only wish to say a word or two. I think that gentlemen forget that we represent here a great country, with great diversity of latitude and circumstances. In regard to feeding cattle in this country, we have three systems which I would define as the pastoral system, applicable to the plains and prairies of the great West and unsettled portions of the country, a "take-care-of-yourselves" system, such as has been referred to by several gentlemen of this Convention, and in the Eastern States, a system growing out of the necessities of the situation—the stall-feeding system. In the discussion we have had, all the examples and illustrations have been made with reference to the "take-care-of-yourself system." I rise for the purpose of making a few remarks, so that it may not go out to the country that this Convention had failed to give its decided opinion of that system of feeding cattle. It is a system adapted, no doubt, under the circumstances which surround a farmer of that region of the country, as the pastoral system is adapted to farmers who inhabit the great plains of the West. Neither of these systems can be applied with any success in the Eastern States, except in the summer months, but would result in an absolute loss; hence let us not forget that there is another system, the stall feeding, which is really the most important system, requiring the greatest amount of care and study in order that it may be a success. I do not desire to say more now, but in further conventions I would commend that subject as one worthy of discussion. The papers read to-day have not referred to that system.

General CURTIS. I do not wish to have it understood that I refer to fodder when I talk about corn. I mean the kernels of corn. When I speak of the entire crop, that is the forage, outside of it. Now, the gentleman asked me if it was possible to grow large corn in Saint Lawrence County, New York. If General Carman came in here, he could certify that I sent from that county here, some which I grew in ninety days, and at the rate of 100 bushels an acre, while the King Philip corn could not have been grown to exceed 40 or 50 bushels on the same kind of land.

Mr. BAKER, of Ohio. The cost of product for a good weight is the

most important to the beef raiser—that is, the lowest cost of product. I was a member of a committee to award premiums at the fat stock show for a class of cattle produced at the lowest cost. The entries ranged from three years old down to yearlings. In one case we were compelled to award a premium for an animal, the cost of the production of which was not two-thirds as much as another animal, when the committee were convinced all the time that the *best* cattle had to go without the premium. The best one would value from 2 to 3 cents per pound above the other. You cannot calculate on the cost of production always insuring the best quality of beef. It seems as though the small corn would be just as well as the large corn.

Professor WEBB, of Delaware. It was far from my intention to say anything, but the best portion of my life has been spent in the State of Maine, and as long as the discussion has commenced here about corn, I wish to state emphatically that Northern corn, our flint varieties in that State, on naturally not very good soil, can be made to yield at least 90 bushels of shelled corn to the acre. This has been tried by many farmers, the ground actually measured, and the corn actually shelled and weighed—not estimated.

While I have the floor, I will state that, for the farmers of Maine, the system of stall feeding is the only one practicable. Referring to one point mentioned in the last paper—the albuminoids fed to cattle—I believe it has already been discovered by the better class of farmers there, in order to feed profitably in that State, it is necessary to have a due regard to the proportion of albuminoids. Where dry grass, hay, and corn are fed, it must be supplemented by some nitrogenous food, such as cotton-seed meal. I have found that I can get a very much better result in beef by feeding grass and cotton-seed meal, or hay and cotton-seed meal, than by feeding corn-meal; and further than this, that we can make our straw and corn fodder very profitable food with a respectable quantity of cotton-seed meal.

Mr. GAINES, of Virginia. To make the most profit by feeding, the system must be a rational one.

Mr. ALLEN, of Maryland. I think this debate is very interesting, but I would prefer that the important points should be discussed more fully. The question is how to produce the best beef at the lowest cost, and we wish also to know whether we can produce a thousand pounds of beef more cheaply—good marbled beef—by using Short-horns than some other breed. I will state that my knowledge and experience, so far as they go, lead me to an unfavorable opinion of Short-horns for the State of Maryland.

Professor KNAPP. I desire to make a correction. Two gentlemen, and among them my respected friend who has just taken his seat, seem to interpret my remarks as pitting the Short-horn against all other breeds. This is not my intention at all. The discussion was between Short-horns and the inferior breeds—the inferior animals—the scrubs. I wish to be understood that as between Short-horns and other kinds that have been bred for the excellence of their beef, I do not know that there is any difference. I would not wish to claim any difference. I simply defended the theory, and the practice also, of superiority in animals that were bred for a purpose against any animal that might be picked up and treated to the best advantage. It is shown that there is a different phase to the problem in different localities. Now, as my friend has stated the problem, the question lies in the economy of cost of producing a given amount of beef. That is not the question altogether. In fact, it enters but slightly into it; that is, the absolute cost. In the

West, where there is more grass than can be possibly utilized, the great value of the Short-horn lies in the fact that you may take a Jersey or a Devon, a well-bred Devon and a well-bred Short-horn, and turn them out to pasture in the spring. The question of counting the spears of grass to determine exactly whether one bites a little closer and takes a little larger mouthful, does not enter into the premises. The question is, whether in the fall, after they have had an equal chance, what have they produced? We find that the Short-horn has gained from 300 to 400 pounds during the grazing season, while the Jersey or the Devon has increased about 200 pounds. Now, in a rough sort of way, you may test that over and over again, as I have, by weights in the spring and fall, and in a measure, that demonstration is sufficent for us. It is not a question with us whether they use more or less grass.

A DELEGATE. May I ask if that is not entirely in accord with what I said? Would you consider one of these cattle twice as good as the other?

Professor KNAPP. At present they would be. The time might come when the question of how many I could raise to the acre would enter into the problem. I simply say that people of different localities must judge for themselves, and I agree, entirely with my friend from Virginia, the only way is to adopt the rational method, every man to determine the breed best for his locality, and even for his farm, and no dictum from this Convention can determine whether this great country shall use either Short-horns, Devons, or any other breed. The intelligence of this country must ultimately prevail and determine for itself.

The PRESIDENT. I am very sorry to be compelled to shorten the discussion, but a gentleman who has a paper to read upon "Butter Standards" is under the necessity of leaving shortly after the close of this session, and we have promised that his paper shall go in. Therefore we will listen to the paper on the Butter Standard from Mr. Thomas D. Curtis, of New York.

Mr. THOMAS D. CURTIS. Mr. President, there appears to be a little confusion of "Curtises" here, but I think I can explain it. My wife knows me as "T. D." We have General N. M. Curtis, of Saint Lawrence County, New York, who lives in the second town from the North Pole, and is one of our best fellows; then we have Col. F. D. Curtis, of Charlton, N. Y.; and then we have Private T. D. Curtis.

I see that Col. F. D. Curtis is credited with having read my paper yesterday afternoon, but as nobody knew it but the compositor, I will now read it again.

ABOUT A BUTTER STANDARD.

By THOMAS D. CURTIS, *of New York.*

In appearing before this assemblage, I assume—

1. That much is known to the scientists that is not yet known to the dairymen, save, perhaps, to a few of the most advanced.

2. That much is unknown to the scientists, who are yet to explore and make discoveries in the unexplored fields.

3. That there is need of interpreters between the scientists and those who do the practical part of the world's work.

On these assumptions, I feel justified in submitting for your consideration a few remarks "about a butter standard."

As regards any definite standard or satisfactory mode of determining the quality of butter, we are literally "all at sea." Much depends on the taste and judgment of buyers, who are generally interested in getting goods at the lowest price. Our so-called experts are mostly selected from this class, and their judgments are as various as their qualifications. And butter varies in quality almost infinitely. We have the variations caused by breed, feed, care and condition of the cows, the length of time

from calving, the water they drink, exposure to the weather, shelter, the atmosphere the cows breathe, the more or less cleanliness in milking and handling the milk, the mode of setting, exposure or non-exposure to air, degrees of light and temperature, the time between setting and skimming, the degree of souring the cream, or acid and no acid, and all the circumstances attending the handling of the milk and its product.

So we have manifold qualities of milk, which must produce manifold qualities of butter, even under like conditions, and these qualities are varied by the manifold circumstances of methods and surroundings. Who can indicate the best method, and the best train of conditions and details, to produce the best butter? There are almost as many answers to this as there are buttermakers, or, at least, as many practices and variations of practices.

And who ever heard of a dairyman who would admit that he made poor butter? Who ever heard of a faithful husband who would admit that his wife did not make as good butter as any other man's wife?

Yet, somehow, 90 per cent. of the butter in market is inferior, if we can believe the estimates of dealers and the confirmatory observation of every *paterfamilias* when he goes out to purchase the family supply. And it is really astonishing what poor butter finds its way to the prominence of an exhibition at dairy fairs, to be passed upon by judges who at best make but shrewd guesses. The extremely good and the extremely bad are easily determined. But when it comes to grades that are fresh and fit for human food, the differences are not readily recognized by even the average expert, and the best, in the estimation of many, is often made to give way for high-color and fancy style of putting up. Since the Jersey boom began, injustice has been done to many good samples of butter by judging it by the Jersey as a standard.

Milk is a very complex, delicate, and unstable product. It is an animal elaboration and secretion from elements contained in the food and drink of the cow, combined with the air she breathes, and influenced by her associations and all her surroundings. According to the fullest analysis which I have seen, it is composed of no less than nine fats, five gases, and eight minerals—in all, 22 elements, some of which are compounds. For aught I know, there may be more ingredients—probably as many, in all, as are found in the animal organism. These elements are: Of fats, stearin, palmitin, olein, butyrin, caproin, caprolin, caprin, arachin, and myristin; of gases, carbonic acid, nitrogen, hydrogen, chlorine, and oxygen; of minerals, potassium, sodium, calcium, magnesium, iron, phosphorus, sulphur, and silica. These elements are held together by a very weak affinity; and the marvel is, considering the popular ignorance of its composition and nature, that milk is so successfully handled and forms so important a part of human food. It is extremely sensitive, and not only rapidly changes from the moment it leaves the cow's udder until it reaches dissolution, but undergoes change in the udder from the time it is secreted until it is drawn. This latter fact is demonstrated by the superior richness of the strippings as compared with the first milk taken from the udder. Hence, milk is not only of various qualities, but is manufactured into butter and cheese under various conditions, few of which are known and understood by the manufacturer.

Let us consider some of the methods for setting milk for cream, and of handling cream until it is churned and the butter product is ready for market

Years ago, in the days of our mothers and grandmothers, the old-fashioned four to six quart pans were the only vessels used in which to set milk for cream. In these it was never set to exceed much over three inches in depth, and in many instances not over two. A room on the north side of the house was usually devoted to this purpose, and no other advantages than the shade thus secured were available for keeping the room cool in summer. Sometimes a place in the cellar was provided for setting milk, and this never had an atmosphere any too pure; but at that time little was known about the affinity of the fats of milk for odors. Occasionally a large dairyman had a milk-house separate from the dwelling. This was usually wholly or partly underground; and now and then one had a cold spring in it. Very rarely some enterprising dairyman had an arrangement for running cold water around his milk-pans.

In those days some very good and some very bad butter was made, as I remember from my boyhood's observations. But there was great lack of uniformity of product in the same dairy, a change in the temperature of the atmosphere affecting the character of the product to such an extent that the season's make of a dairy was a very good meteorological record. Those were the days of private dairying.

In winter the milk was generally set for cream in a buttery adjoining the kitchen and sitting room, if it was not set on shelves put up for the purpose in the kitchen. Winter butter was then white and flavorless, though often bitter, owing to the poor feed and lack of shelter for the cows, and to the variable temperature of the room in which the milk was set, the temperature often ranging in twenty-four hours from 70° or 80° down to freezing and below, for there were no base-burners in those days, and the wood fire went out at night, and had to be kindled anew every morning.

With the introduction of associated dairying came the method of deep-setting milk

for cream. This was done in pails 18 to 20 inches deep and about 8 inches in diameter, set in pools of water. Then began the practice of robbing Peter to pay Paul—of taking the cream off from a portion of the milk for making butter and making the impoverished milk into cheese. The establishments in which this was done were called "creameries." The cream was churned sweet, and we heard for the first time of sweet-cream butter. It was pronounced good when first churned, but the complaint soon arose that it lost its flavor and would not keep. No such complaint was ever heard before. The best butter was always the longest keeping, the conditions being the same. But here was a good butter soon going off flavor, if not rapidly hastening to decay. At first the verdict was, that churning the cream sweet was the cause of the short life of the butter. Little or no sweet-cream butter had ever before been made—at least not enough to attract attention. The public mind accepted this hasty and superficial view, and thenceforth sour-cream butter became the rage, and is clung to now with almost superstitious tenacity.

There was another difference in condition which was entirely overlooked. That was the difference in the mode of setting. The old-fashioned tin pans exposed a large surface of cream to the atmosphere; the deep pails exposed but little surface. The only thing that the difference in depth suggested to the popular mind, was the question as to whether all the cream would rise in the deep pails. This was decided in the affirmative as only a question of time; and the cool-water pool system afforded the requisite of keeping the milk sweet for a sufficient period.

But comparatively recent experiments made at Cornell University, New York, demonstrated the fact that, in the absence of oxygen, no butter or cheese flavor is developed. These flavors are not in the milk, but are the product of oxydation. In cheese this oxydation is subsequent to manufacture; but in butter it must be prior to manufacture and be secured by exposure of the cream to the air, from which it absorbs oxygen. It will be seen that the old-fashioned shallow pans exposed a large amount of surface to the air and thus furnished the requisite condition for oxydation. Prof. L. B. Arnold says this is best accomplished while the cream is rising. The deep setting, on the contrary, exposed little surface to the air, and from the fact of churning the cream sweet, it appears the time of exposure was shortened. The flavor of the butter churned from it must have been a very mild, creamy one, pleasing only to delicate palates, and the sequel showed it was very evanescent.

Souring, it would seem, imparts a flavor of its own, according to the degree of souring; so that the cream from the shallow setting had the advantage not only of the flavor imparted by oxydation, but that added, or the modification produced by souring. The practice of souring the cream before churning was soon adopted by the creameries. From this point they began to lead the private dairies in price, because of uniformity of product if for nothing else, and this practice of souring cream is now carried to an astonishing extreme by some of the Western creameries and butter factories.

But notwithstanding the lead taken by the deep-setting creameries, the idea of shallow setting still possessed the public mind. The economy of setting in fewer vessels, however, was recognized; and to meet both the feeling in favor of shallow setting and the demand for economy in labor, the large shallow pan was devised for setting the entire milking in one mass. At first, water running under the pan was considered indispensable; then the water was run around the sides; and finally, the idea of controlling the temperature of the milk-room by the use of ice was brought into practice and the milk allowed to cool down gradually without the use of water. This system is adopted by some of the best butter-makers.

It was found that cream rises best when the temperature of the milk is falling, because the water and casein in the milk cool much more rapidly than the cream, thus making wider the relative gravity and hastening the ascent of the cream. The result has been slow cooling in shallow setting, and rapid cooling in deep setting. This discrimination very generally, if not universally, prevails.

There is one objection to the process of cooling in water which does not appear against the process of cooling in air. With water-cooling, the milk soon becomes cooler than the surrounding air in the room, and hence condenses the vapors in the air, which fall like dew on the surface of the cream, which consumes whatever odors the condensed vapor may contain. With air kept colder than the milk—or at least as cold, which will always be the case when the air is the cooling medium—there is a constant exhalation from the milk, which is absorbed by the surrounding air; thus, a process of purification of the milk is going on all the while, while with water-cooling the action is exactly reversed, and the milk, to its own injury, after it reaches a certain relative temperature, is all the while purifying the air. This is a fact which seems entitled to no small consideration.

There are bureaus contrived for setting milk that cut off all exposure to the air. One completely submerges the milk in water, thus preventing all ingress of air or odors, while likewise preventing egress. Another cools the milk in ice-water, the can having a ventilator at the top, which may be kept open while vapors are escap-

ing from the milk and closed so soon as the milk gets as cool as the atmosphere. Both of these bureaus are economizers of space, but, as both exclude all possibility of oxydation by exposure to the atmosphere, the cream raised by both has to be soured before churning. There are other inventions for setting milk for cream which it is not necessary for my purpose to mention here. I am only considering conditions which I think must affect quality and flavor.

Let us now consider for a few moments the question of acidity. I drop the question of which is the better, sweet-cream or sour-cream butter, and confine myself to the question of the degree of acidity and the effect of acid on the product.

The advocates of souring cream are widely apart. Their positions may be summarized thus:

1. Skim as soon as the milk begins to change and shows a little loppering on the bottom of the pan, and churn as soon as the cream is slightly sour.
2. Skim after the milk loppers and churn at once.
3. Skim sweet, and churn the cream when it turns positively sour.
4. Skim sweet, and let the cream stand until it begins to lopper.
5. Skim sweet, and churn the cream "just 12 hours after loppering."
6. Skim sweet, and let the cream stand until the whey begins to separate; then draw off the whey and churn.

Thus we see there is a wide difference in the degree of acidity. We are told by good authority that the more the acid is developed the more it consumes the flavoring oils of the butter and the less the yield. This, it would seem, must affect both quality and flavor. Yet the extreme degree of souring is practiced by some of the creameries and private dairymen of the Northwest, who get the highest prices for their butter.

But taking a common sense view of the matter, it would appear that butter churned from loppered and wheyed cream must have a large amount of casein mingled with it, and that there is not only a great loss of butter flavor proper, but an addition of cheesy or sour-milk flavor. Indeed, there is good authority for saying that much of the high-priced fancy butter, fresh from the churn, sold in the cities, is flavored principally with buttermilk, and is inferentially very short-lived; but some people have acquired a relish for this new-buttermilk flavor, and are willing to pay a high price to get it on their tables fresh every day.

It hardly seems possible that butter made from cream so far gone on the road to decay, can be as good-flavored or as long-keeping as butter churned from properly oxydized sweet cream—unless by souring we get rid of some element of decay, or the acid developed takes on a comparatively permanent form, like vinegar, and resists further change. The flavor of sour-cream butter is certainly different from that of sweet cream, and consumers have the right to their preferences. But can the scientists throw any light on the subject, so that we may know precisely, or even approximately, what effects are produced by the different degrees of souring, and whether there is any difference, so far as wholesomeness is concerned, in the products of the different degrees of acidification.

There is one fallacy which ought to be dispelled for the benefit of all dairymen, and that is the idea that the quality of dairy goods depends on the brand of salt used. Good butter-makers will make good butter no matter what brand of refined dairy salt is used; and if they are not good butter-makers, salt will not save their butter. It has much to do in seasoning butter and qualifying flavor. It may even, by excessive use, destroy fine flavor or cover up a mildly bad one. Chloride of sodium is the same everywhere on the face of the earth; and if injurious impurities—which are of the same kind everywhere—are carefully eliminated, no harm can come from its proper use. There is no foreign salt made that is better than our own chemically purified American; and since this is cheaper than any foreign salt, both pride and patriotism ought to induce American dairymen to give it the preference, while common sense and business shrewdness ought to prevent their being imposed upon by the misrepresentations of the agents of foreign salt companies. We, as Americans, cannot do too much to encourage and protect our home industries and develop our natural resources.

Temperatures range quite widely in setting milk, and these may have something to do in modifying flavor. We have not only slow and rapid cooling, but in rapid cooling the temperature is often run down to near the freezing point. This produces a frothy, bulky cream, but no one yet seems to positively know how flavor and keeping quality are effected by this low temperature. It is admitted by dealers that dairy goods kept at a low temperature in cold storage have to be soon consumed when taken out, to avoid deterioration. Does low cooling produce a corresponding effect in the materials out of which dairy goods are made? It is reasonable to suppose that it may. It may yet be found that there is a medium temperature at which milk should be set, cream kept, and the product stored.

Churning is usually done at about 62° Fahrenheit. Yet I know a successful dairyman who always churns at 64°, and I heard one declare, at the national butter, cheese

and egg convention, held in Milwaukee last December, that he always churned at 58°. We may infer from this that different temperatures are required for different conditions. In one instance, at least, a different temperature was demanded for sweet cream. John Gould, agricultural editor of the Cleveland *Herald*, relates the case of a neighboring creamery in which the buttermilk was churned in order to get all the butter. The cream was churned sweet, at the usual temperature, or about 62°. It was suggested that the churning be done at 10° lower temperature. This was tried, and resulted in getting all the butter the first time churning. This was a wide difference and a low temperature for churning. It might not work in all cases; but this instance unmistakably points to a lower temperature for churning sweet cream than for churning sour.

It is a mistake to treat cream in all conditions by one unvarying rule, regardless of the differences. So of other variations, produced by breed, feed, time from calving, season of the year, &c.; and the milk and cream from different cows, and even from different herds, may require different treatment to secure the best results.

One more point, and I will bring my paper to a close. At the late convention of the national butter, cheese and egg association, held in Milwaukee, the buyers of the East cautioned the butter-makers about high coloring. They had been troubled with high artificially-colored butter quickly going off flavor. They did not appear to know the reason for this; but it is not unlikely that the coloring matter acts as a ferment. All artificial butter colors are of vegetable origin. I have personal knowledge of the unpleasant, smoky-like flavor imparted by carrots, which soon becomes unbearable. Most of the commercial colors for butter are prepared from annato, which is cut with oil. This oil mingles with the butter, carrying the color with it. It may also aid in hastening rancidity. But whatever the cause, the hints of the dealers are worth heeding. At best, artificial coloring can gratify only the esthetic taste, as it has no flavor to impart but a bad one, which, if not at first recognized, is imperceptible simply because of the small amount used. But this small amount may very soon become an active leaven.

In conclusion, permit me to say that the want of a rational standard of excellence for butter is felt by the dairymen. In the Northwestern States some effort has been made to establish one. This is based on a certain number of points as perfection, and is given thus by Hiram Smith, of Wisconsin: Flavor, 20; quality or grain, 12; color, 6; salting, 6; style of package, 6; total, 50. This, however, is entirely arbitrary, and serves only as an aid to the judges, by directing their attention to the several divisions named. With it, there is scarcely a possibility that any two sets of judges would agree on the same number of points for any one package, if they acted independently of each other.

My aim is to call attention to the subject of this brief paper. If I shall succeed in making abler and more scientific minds think on it, and thus lead to investigations in the directions indicated, I shall feel abundantly rewarded.

It is said "the proof of the pudding is in the eating." But the good cook knows how to make several kinds of pudding, and to make each with a comparative degree of certainty. So the proof of the butter may be in the eating. But the butter-maker ought to be as skillful as the pudding-maker, and not jumble all flavors together so that we cannot recognize any of them.

Professor KNAPP, of Iowa. I desire to express my great gratification at the paper read by Mr. Curtis. It covers over the ground which we have been traversing for some years, and expresses those principles so tersely, so lucidly and so thoroughly, that I think we owe him a debt of gratitude. We have been trying the various problems to which he has alluded at our station. I will just mention one point. I have tried to preserve butter. Preserving butter and keeping it sweet is not so difficult; that is, that there shall be no positively offensive flavor. But I have been trying to preserve that fine flavor, so delicate to the taste, which commands such an extraordinary price in the markets. I have tried all the methods of different countries, and I do not know how that capricious little rascal we call "fine flavor" gets out of the box into which we put him. Somehow, by hook or by crook, he does escape, and we have not been able to retain that fine flavor which new butter has. So far, it seems to me that the only thing left is to consume the butter while it is comparatively fresh.

Mr. GAINES, of Virginia. I would like to ask some of the scientific gentlemen present, who have made these subjects their study, to explain rather more fully the point brought out in this very interesting

paper in regard to sweet-cream butter, and the changes which take place—the point at which it should be churned to make the best keeping and best flavored butter. We are told by chemists that there are three stages of fermentation: the first, saccharine; the second, acetic; and the third, putrefactive. In applying this to butter-making, it would seem that the sweet cream was taken at the saccharine fermentation. Now, let us see if we can understand the chemical *rationale* of the action which takes place. I do not profess to be able to explain it, and I simply wish to make myself sufficiently understood, in order to secure the information from some of the scientists present. You take this milk and set it away for turning, as it is ordinarily called. So soon as the saccharine fermentation has taken place, you get sweet-cream butter. You allow the fermentation to go on until the acid fermentation has developed, and you get the other kind. If you allow it to go on until the putrefactive stage is reached, you get another distinct butter, and the greater the extent of fermentation the worse for the butter.

Mr. T. D. CURTIS. I am unable to answer the gentleman's question. I can only give him the testimony of some of the experts in this country and Europe. They all agree that sweet cream is not only the best but the longest keeping. Professor Arnold, on our side of the water, and Professor Voelker, on the other side, the chemist of the royal agricultural establishment, say you cannot churn your cream too sweet to get the best flavor and best keeping butter.

Mr. GURLER. I am not a scientist, but a true butter-maker. I have followed the business of butter-making for ten years, and I will tell you my experience—something that I have learned in regard to sweet-cream butter. I have learned that when I churn my cream sweet, too much of my profit goes to the pigs.

A DELEGATE. Have you ever tried a lower temperature?

Mr. GURLER. No, I have not. My experience is, that when I undertake to churn cream at that temperature, it swells. If I start the churn when it is half full, I must draw out half before I churn it. I think you can put it out if you only give friction enough, but I would not want to turn the crank. I would prefer steam-power. Now let the cream go until it gets a little acid. When the whey forms there is a loss in quality. Before any whey is formed, I find that I get the best yield and the best flavor of butter. During the last two years I have been investigating this gathered cream business, and there is where I discovered most distinctly the loss in churning the cream sweet, and in that line, in the extreme hot weather, it is almost impossible to get the cream into the feeder before it becomes so sour that it is wheyed. I know there will be a loss in quality when it gets to that extent of acidity. Now I want to speak of Professor Knapp's rascal, that fine aroma. I wish we could find some process of keeping it where we put it.

A DELEGATE. Feed your cows on leeks and you will have it. [Laughter.]

Mr. GURLER. That is not the kind of aroma we want. Now as to this butter that has been kept so long and held its flavor, I think the aroma never was there. They never got it at all. I am from the vicinity of Elgin, and I take great pride in the Elgin butter. When we get the butter we desire and detect that aroma, we think we have something pretty nice, and we do not want to tie it nor get it right close to our noses to detect it. I am not a public speaker. It is out of my line entirely, and I will say no more.

Mr. SANDERS. While Mr. Gurler is not a public speaker, he is one of the most accurate men I have ever known.

Professor KNAPP. I wish to state one fact corroborating what the gentleman has said about the loss of butter by churning sweet cream. I will give one experiment. We took a certain amount of sweet cream, and churned it at sixty-two degrees. We obtained ten pounds of butter. I said to the operator, when he reported the amount: "There is a very large loss; it must be in the buttermilk. Now do not throw that buttermilk away—we will hold it until acidity takes place. In its lactic acidity we churned it again, and obtained six pounds more of butter.

A DELEGATE. Which was the best butter; the best quality?

Professor KNAPP. Really, I would not like to state here. [Laughter.]

Mr. GURLER. I will say I can conceive of one way that we can work our cream sweet with profit, in connection with the creamery, where we are making butter and cream cheese. If we take the cream for butter and churn it sweet and add that, and take the buttermilk to make cheese, we will get it in that way. Perhaps the loss in butter might be made up in cheese. I can conceive of no other way in which it can be done with profit, unless by churning it at ten degrees lower temperature, we can get it all.

Mr. FORD, of the District of Columbia. I have had some experience with regard to preserving butter. Butter can be preserved any length of time without salt. Salt has no preserving qualities, and if butter is to be kept for a long time it is better to put it down without salt. A method which I adopted some years ago was as follows: I packed my pot with butter to within an inch and a half of the top. Over the top I put a piece of cotton cloth, wetting it with cold water; over this I poured melted lard. This was put away until used, and I have known butter to keep two years in that way.

The CHAIR. The next subject is the swine problem. Several papers are before us, and gentlemen are prepared to read them. What is your pleasure, gentlemen?

A DELEGATE. I move the Convention take a recess until 2 o'clock p. m.

The motion was agreed to.

AFTERNOON SESSION.

The CHAIR. The Convention will please come to order, and now listen to a paper from Col. F. D. Curtis, of New York, on Swine. Mr. Curtis is considered authority on this part of our animal industry.

Mr. Curtis then presented the following paper:

AN ADDRESS ON SWINE.

By Col. F. D. CURTIS, *of Charlton, N. Y.*

VALUE OF PIGS.

The number of swine in the United States, reported by the census of 1880, is 47,683,951. They exceed the horses of the country nearly five times, and outnumber the cattle more than eleven millions and a half, and the sheep nearly twelve and a half millions. Swine also show the largest rate of increase from 1870 to 1880, viz, 90 per cent., while that of sheep is only 24; milch cows 39, and other cattle 66; oxen 25, horses 45. No other kind of animal food is so universally eaten as swine's flesh, and no other animal contributes any such proportion to our exports, or helps to turn the balance of trade in favor of our country.

PARASITES—TRICHINA.

Notwithstanding the suspicions which have been cast upon American pork by foreign health commissions, and the edicts of governments debarring its importation, and thereby causing unnecessary expense and trouble, the records of mortality in America demonstrate beyond dispute that there are fewer diseases caused by its consumption than in any other country. I venture the assertion, without fear of contradiction, that the swine of the United States are freer from parasites, and that there is less disease amongst them on this account, than anywhere else in the world. This being the case, it follows, as a matter of course, that fewer people are affected by trichina in this county than in any other; therefore, the restrictions imposed upon the sale of American pork—hams and bacon—are unwarranted by the facts, discriminate unjustly against American producers, and serve to increase the price of meat for the people, whose rulers are thus unwarrantably prejudiced and short-sighted. The methods of feeding in the great pork-producing districts, which furnish the exports for this country, are not conducive to the production of parasites in the flesh of swine, nor is this a resultant effect of climate, but the opposite. Corn, the great staple, is the purest kind of food. and ranging in the open air on the naked ground is also promotive of more healthful growth, as compared with the system of sty-rearing and feeding so common in other countries. An excess of corn-feeding undoubtedly causes injurious effects on swine, not in the way, however, of producing parasites in the flesh; and a constant exposure in the open air undoubtedly decreases the profits, but by no law of cause and effect, that I know of, would such exposure generate trichina or other parasites in their flesh.

PORK IS MADE TOO FAT.

The objections to eating pork arise from other causes, and may more properly be charged to following the fancied notions of a fashionable popular extreme, originating with the British breeders, and copied by Americans, without regard to the demands of common sense and hygienic laws. Following this line of so-called improvement, the natural pig has been changed to an unnatural one. Pig raisers have too generally adopted a system to make the most rapid increase; they have supposed this to be the most profitable. They have acted upon the principle that the more food which could be stuffed into a pig the better, and breeders have been governed by the same idea and have endeavored to condense pigs, as far as possible reducing the bone, muscle, and other parts to fat, so that the modern improved pig has become little else than a mass of animated lard. Such pigs are not desirable food, and people show their good sense by not wishing to eat them. Improvement has reduced the demand for pig meat in the cities more than one-half, and in the country it has lessened its use in farmers' families. Why?

Because the American stomach has not kept pace with this kind of improvement in the feeding and breeding of pigs. If our stomachs could be made to digest lard four inches thick, then we might continue this kind of improvement; but since they will not, we had better reduce the four inches of fat somewhat, grow meat instead of lard, and try to produce food which will be more palatable, digestible and salable. There must be more muscle and less fat, more length of body and less clumpiness. In order to produce this condition there must be more exercise and less stuffing, which condition now characterizes pig-rearing too generally in the Eastern States and with breeders. The rich food must be kept from the pigs, or fed in very moderate quantities, until the rounding-up time, just before slaughtering. My idea is that the body should be made first and the fat should be added afterwards. This will make healthier meat, and more palatable, also, than to keep pigs in a continuous condition of overfatness.

EXCLUSIVE CORN-FEEDING INJURIOUS.

I have remarked that corn is the purest kind of food, but when pigs are fed exclusively on this kind of diet it is equally true that it produces a feverish and unhealthy condition and lays the foundation for bodily ailments, if it is not directly the cause of producing them. It will create inflammation of the bowels and disorders of the stomach, which may prevail so extensively in a herd as to be considered contagious, leading to the conclusion that hog cholera prevails. The digestive apparatus of the pig is nearest like that of a human being of any quadruped, and it is also subject to many of the same diseases, to-wit, rheumatism, quinsy, inflammation of the lungs and bowels, with stomach disorders. The human stomach and constitution will give way under a diet as stimulating and fevering as clear corn, especially if the system is kept in a gorged state for a considerable length of time. The hog will stand it longer, perhaps, but will as surely succumb in the end. It is a higher order of farming when sanitary laws are applied to the rearing and management of farm animals. It is gratifying to know that under the leadership of the agricultural

press there is a rapid advance being made in these respects. The best remedy for stomach and bowel disorders lies in preventive rather than cure. Hogs should have the range of a clover field or be fed liberally with sweet corn-stalks, or the early-maturing sorghum and roots in their season, with plenty of pure water. When this is done the injurious effects of eating a large quantity of corn will be obviated, and even *young pigs* will keep healthy. If this system would be more generally adopted in the West, there would be less of so-called cholera and more lean meat in proportion to the fat, which would help to create an increased demand for pork.

This is not all the advantage to be derived. The peculiar oily flavor which somewhat characterizes pork made in the Western States would be lessened. It is undoubtedly a fact that the flavor of pork, as well as its consistency, is affected by the kind of food from which it is produced. Mast makes very oily and rank pork. It would also be conducive to the health of the younger pigs, and add to the profits of growing them, if they should be allowed to go into a separate inclosure, where they could be fed wheat middlings or other lighter foods. There is no b tter food for young pigs, to supplement their mother's milk, than oats; they may be fed whole. The least trouble attends this kind of feeding, which would be an important consideration with many. Everybody knows that cow's milk is the best food for young pigs, next to their mothers', but with large breeders of hogs there is never enough of cow's milk to go around. The Western farmer is somewhat averse, with his larger areas, to the painstaking care which is practiced, and more necessary, perhaps, in the older States, but which he could follow with unquestioned benefit to his business.

PASTURE AND FEEDING.

Many farmers do not appreciate the value of a clover pasture for pigs. The hog is an omniverous animal and takes to clover or even grass, in the absence of other food, as freely as a cow or a horse. I have fitted a grown hog for slaughter on sweet corn-stalks alone, fed green. Sorghum is still better, but not available for so long a feeding season. My system of wintering and summering swine, which has the commendation of being successful, is to feed apples, roots, bran, and corn in winter, with the house slops; and in the early spring to turn them into the orchard, which is seeded with orchard grass. This grass furnishes the earliest bite of any, and is very much relished by the swine, and besides, when once well seeded, it will last for a number of years. Following the orchard grass, the clover comes next in order. The orchard grass on good land will renew itself every two weeks for a fresh bite, and is admirably adapted for a separate feeding range for the young pigs, while the older ones are confined to the clover fields. By the time the clover is used up, the sweet corn-stalks and sorghum will be sufficiently matured for cutting up and feeding in their order. When frost comes and destroys the succulence of these, the r oot field should be ready to turn into and let the hogs help themselves. Corn or other grain may be fed conjointly with the succulent food we have spoken of, and it will be found that a little will go a great ways in promoting a healthy and profitable growth. A field of pease to turn into will also furnish excellent food at little cost. Barley is the best grain, ground entire, to make milk for mothers when suckling young. It is evident that under the pasturing system, more hogs can be kept with the same amount of corn, and that one field will suffice for growing the entire amount of green feed, the size being proportionate to the demand. It would be a wise forethought in a man who proposed to rear hogs, to plant an orchard of early maturing varieties of sweet apples for his hogs to feed upon in the orchard, which should be made a permanent pig pasture.

What a natural and sensible combination this would be—the apples producing growth for the pigs, and the pigs in their turn making more growth of apples—an equilibrium of profitable forces without any extra labor. My experience teaches me, also, that there is no more effectual method of enriching land and preparing it for good crops afterwards, than by rearing swine. Hogs possess a value as auxiliaries on the farm, to increase its richness and to afford a profitable home market, which is not valued so highly as it might be. As g nerally managed, hogs do not increase the fertilizers of the farm as much as they would if they were allowed to become more active factors; when shut up in a pen, as usually cared for, a pig adds comparatively little to the manure pile.

MAKES THEM HEALTHIER.

Pigs allowed to range and fed in the pure air, with cleanly surroundings, will have pure blood, which in the course of nature will build up healthful bodies. They also have the opportunity to resort to remedies and antidotes which their instincts may prescribe for their bodily ailments. These out-of-door pigs would not show so well at the fairs, and would probably be passed over by the judges and people, who have been taught to admire only the fat, feverish, helpless things, which get the prizes, but are really a caricature on fathers and mothers. Such pigs are best adapted to

fill lard tubs, and to make doctors' bills; whereas the standard of perfection should be a pig which will make the most ham with the least waste of fat, the longest and deepest sides with the most lean meat. It should have bone enough to allow it to stand up and help itself, and carry with it the evidence of health and natural development in all its parts. Pigs which run in a range or pasture have good appetites; the fresh air, exercise and change of diet give them this; hence they will eat a great variety of food, and much coarser than when confined in pens. On a farm where pigs are kept nothing need go to waste for lack of a market.

SHELTER AND CARE.

I am so thoroughly convinced of the importance of shelter for all kinds of stock that I must pause here to urge the necessity to all breeders of swine to furnish adequate protection for their pigs from the cold. I know corn is sometimes cheaper, in some places, for fuel than perhaps either wood or coal; but it cannot be so cheap to shut out the cold and keep up the warmth of life as hemlock boards or other shelter. A fence corner is certainly not a profitable furnace in which to burn corn to keep hogs alive. In just such places, however, large quantities of corn are used up to maintain sufficient carbon to keep the hogs alive. As pigs are generally wintered over in the West, and quite too often in this way, this system must be a costly one and must necessarily reduce the profits very materially. I am glad to know that western farmers are finding out and practicing the importance of not depending upon an exclusive corn diet for their hogs, and as a result there is less of hog cholera, as well as other diseases; and that they are also gradually warming up to the idea that a freezing condition for their hogs nearly half the year, is not the wisest kind of treatment. A valuable lesson may be learned in this respect also all over the northern States, where a warm and comfortable pig sty is the exception. Ten cents invested in stopping cracks and shutting out cold will always save one hundred in feed.

KINDS AND BREEDS.

Of breeds we have an abundance, each possessing merits peculiar to itself. These are sometimes, it is true, very finely drawn out in order to distinguish them, and reach such an infinitesimal point of difference that it takes quite a stretch of imagination or self-interest to discern them. Unlike the swine-breeders of Great Britain, we have not claimed a breed for almost every county, nor yet for each State. Unlike them, we call crosses crosses, and not breeds. More pains are taken in this country to breed swine pure and to maintain perfect pedigrees than in Great Britain, where crosses are often "stolen in," and this kind of "improved" stock is purchased by gullible Americans at high rates, and, under the delusive title of "imported," sought after by other gullible citizens, or by those whose wealth has helped to create a fashionable aristocracy in pig-breeding as well as in other stock, which looks down upon American-bred animals, and boasts of long prices paid for foreign-born. American breeders cannot compete with this fashion, founded on money, which asks no questions and calls for no pedigrees beyond a high-sounding name; and so the keen-sighted English breeder will probably continue to make his crosses and to sell them to Americans for fancy breeding, while the more practical American breeders, making utility their standard, are perfecting the Poland-Chinas and the different families of Red Berkshires, which will eventually lead, if they do not supplant, the others as thoroughbred swine for general purposes, or in other words, as the great market hog. You may ask, "Why this bold statement?" Because they possess the characteristics which come nearest to the demands of the American market, and they are also freest from the objections which affect most other breeds. Pure-bred white hogs are rapidly losing ground in the great hog districts of the West, because they possess thinner skins, which make them more susceptible to all kinds of skin diseases, mange and measles and sunburn in summer and scab in winter. Poland-Chinas are now the great leading breed, and they have the honor of being American in their origin. Painstaking and skillful American breeders perfected the crosses and established the breed. The old red blood, an offshoot of the early importations of Berkshires, is now being perfected by careful selections and crossing of the different families. This blood has been preserved in New Jersey, Connecticut, and New York for nearly one hundred years, and so strong and marked were the characteristics of this ancient breed that notwithstanding all of the out-crosses of these years it has not run out, but has preserved the original characteristics in form and color to a wonderful degree. It takes a long time to make a family of swine thoroughbred, and it takes an equally long time, or longer, to weed out all of the distinctive features.

Nearly a century has not eradicated the taint of crossing the Berkshire upon the Yorkshire, which is proven by history and the black skin spots and the occasional black flecks found on the Yorkshires. The red hogs have carried the marks of their Berkshire origin all these years, shown by black flecks and the pendant ears, and what

is more marked and gives them greater value, they have not lost the ancient Berkshire peculiarity of possessing more lean meat than other breeds. The so-called improvement of the modern Berkshires by crossing them upon Chinese, or Siamese, or Essex, or all, to shorten the snouts, fill up the cheeks, and round up the bodies—in short, to make them finer, in obedience to a mistaken but popular fancy—has had the effect to make them fatten younger, and at the same time to decrease the muscle which makes the lean meat. I am of the opinion we have progressed too fast or too far in "improved" pigs. It is best now to halt and endeavor to make the best use of what we have and take a new road. We have gotten as good blood as we need, and the right thing is to use it to the best advantage. We have several large breeds suited to all the wants of the nation. At the head stands the Poland-China, black and white in color; Red Berkshire, red in color; large Yorkshire White; and that most excellent American breed, the Chester Whites; and Cheshire, also American. The same is true of the smaller or finer breeds—the Essex Black, the small Yorkshire, Suffolk and Lancashire White—and all essentially the same blood. There are breeds, medium in size, which combine earliness of maturity with greater weight than the small breeds: the Berkshire, *par excellence*, black with white points, and the Victoria White, another American breed, originating in Saratoga County, New York. All of these breeds are useful and have their fanciful admirers. They are all valuable for crossing upon native stock, and in all cases will improve them. This is according to physiological laws, admitted by all who have given the subject careful consideration; namely, that the stronger blood will improve the weaker—thoroughbred blood will improve native or mixed. I should like to see importing stopped and the purses and brains of men turned to a united effort to improve our own swine, not the various breeds so much as the great total which supplies the markets, and from which the farmer makes his profit or loss. To do this there must be continued and extensive breeding of thoroughbred swine. There will always be an active demand for this kind of stock to fill the pens of fancy breeders and for use in improving the great mass.

BEST PIGS FOR PROFIT CROSS-BRED.

I believe most of the cattle which have won the first prizes at the fat stock shows have been either grades or cross-bred. This would doubtless be true in regard to pigs, if the prizes were offered in the same way. The farmer wants the best pigs for profit. It is his interest to secure these, regardless of breed. The majority do not own thoroughbred hogs, nor have they the means to stock their farms with them. My personal experience and observation have taught me valuable lessons in the breeding of pigs. I have been aiming for more than a quarter of a century to obtain the best pigs for profit to feed and slaughter.

I used to think that the small breeds of hogs were preferable to the larger. The reasons which led me to this conclusion were all good enough and true enough, but they did not cover the whole ground. I was breeding the small kinds of pigs, and, like everybody else, thought my own must be the best. My arguments in their favor were conclusive to me, and ran thus: Two small hogs can be kept in the place of one large one, and while it may be true that they will not make as much side pork, they will make four hams and four shoulders, which are more desirable than the pork, and they will also make more lard, which is a valuable part in the animal; and if well bred, the two would probably not have more offal than the one and no more in weight of the inferior parts, heads, and legs. This kind of argument controlled my pig breeding for years, coupled with the notion that short-nosed, chubby pigs were so much handsomer than the coarser ones. There was one mistake, however. It takes more feed to sustain two lives; to run two sets of machinery than one. There was a a kind of popular notion in those days that pigs must not have any noses, or, if they did have any, they must be buried up in fat cheeks; everybody forgetting that a snout was a natural appendage to a pig and made for a wise purpose—to enable it to get its living; and that there was also a law of nature that length of extremities and length of body were also in natural proportion. The shorter a pig's body is, the thicker it will be, and this thickness of body also involves another principle, that this thickness must be made up of fat. A chubby pig is an inactive one, and on this account there must necessarily be less muscle (lean meat), for it takes exercise or physical action to develop the latter. The want of activity, which is a natural characteristic of the fine or chunked breeds of pigs, is the reason why they fatten so readily. While we were breeding these round and plump beauties to please the eye and gratify an æsthetic taste, the stomachs of people began to revolt at so much fat, and butchers complained that they could not sell the meat. There was too much waste also in the hams and shoulders, as they contained too large a proportion of fat; such kinds of pigs were also unsuitable to make sausage, which is an important item in their consumption.

These hogs are as a rule small breeders in the number of their progeny, and, what is equally important, in the size of the young. When born they are very small and grow

slowly. It is true that they will fatten younger than the coarser breeds, having a natural inclination to take on flesh at a younger age.

It is this natural characteristic which gives them their greatest value, and which the farmer should turn to good account. This may be done by crossing them with the coarser breeds, so as to unite the characteristics of larger growth with that of earlier maturity.

This is science. It is a philosophy which may be easily applied. It has taken more than a century of careful breeding by painstaking men to establish these peculiar characteristics in the finer breeds of swine, which are exemplified in the form of their bodies and in their disposition, and which give them a special value for the purpose indicated. It is necessary that they should be bred pure in order to maintain these characteristics, and the more thoroughbred they are the more they will be intensified in the blood. Hence, the more thoroughbred the stock, the stronger these tendencies will be in the offspring. For these reasons, mongrel or even cross-bred sires should never be used, as such blood will not produce as complete results as with the pure bred. To produce the most profitable offspring, a thoroughbred sire should always be used. When the dam is of a coarser breed there will always be more young, and they will be larger at birth and begin to grow sooner and faster than with a dam of a small breed. Sows of the smaller breeds will average about half as many pigs as the larger ones, and they do not possess the capacity for giving milk equal to the latter, and being more inclined to be fat, the young pigs at birth are generally weaker and less able to take care of themselves; hence there is always a larger percentage of loss. This important fact should not be lost sight of in selecting a breeding sow. The sow should be long and deep in the body, the opposite of chunkiness, with good bone, inclined to coarseness rather than fineness, which will furnish the framework for a good body.

This is what is wanted, a good strong frame upon which flesh may be formed. If the mother is properly selected, she will produce such a frame and furnish the milk to sustain it and a constitutional vigor and appetite for the consumption and assimilation of food. This is what the farmer wants in a pig, namely, an ability to change the product of the farm into a more profitable condition; hence the more of it he can have consumed and made into pork the better it is for him. A strong frame carries with it a strong appetite, and this is essential to make growth. These are the qualities which may be obtained from the dam, while from the sire there will be imparted a tendency to take on flesh rapidly, and a roundness and plumpness to the body, with a greater fineness to the bone and extremities, and a lessening of the offal; in short, such a cross will make a pig as nearly perfect as possible in its combination of all good qualities.

The term "cross-bred" refers to the uniting or crossing of distinct and established breeds, as, for instance, the crossing of a small Yorkshire or Victoria pig upon a Poland-China or Berkshire, which would produce an offspring that would be cross-bred, and contain one-half of the blood of both sire and dam; so that it would be half small Yorkshire or Victoria and half Poland-China or Berkshire, as the cross may have been made. Sires produced by such cross-breeding should not be used, for the reason that they would not possess the ability to transmit any special qualities or fixed type to their progeny. In other words, they could not impart any uniformity of characteristics to their young, because their blood being mixed and inherited from sire and dam of dissimilar form and nature, their offspring would be also mixed and liable to be large and small, reverting back to the peculiarities of the original blood. This is a law in breeding which every old breeder has observed; and it is also true that in the first cross or intermingling of blood of two different breeds, there is generally a uniformity in the offspring, combining in the one animal the characteristics of both. To illustrate: In the cross of a Victoria sire (white) upon a Berkshire dam (black with white points) the pigs were all white, with no indications whatever that they were really half-blooded black. In form they combined the peculiarities of both breeds. These half-blooded pigs, perfectly white, bred together, produced black and spotted pigs, quite dissimilar in other peculiarities, thus showing the natural law of reversion, and the folly of breeding cross-bred stock together to make any improvement.

The more marked the difference between the original parents, the more marked and unsatisfactory the offspring will be when the second or subsequent crossing is attempted. The law of reversion will so far assert itself that extremes of difference, *i. e.*, almost opposites, will appear, so that no beneficial or profitable result can be secured by continuous cross-breeding. Breeding the half-bred female back to a male of the original blood will only result in gradually bringing up the type and characteristics to such original blood. Nothing is therefore to be gained by such breeding, as it would save time and trouble to commence with the original stock and have at once the benefit of all the natural qualities. To sum up the whole matter, so far as cross breeding is concerned, to get the greatest profit there should be but one cross, the original sires and dams being kept for the purpose. These are the lessons of science.

In regard to the other term, "mongrel," it is not used in any opprobrious sense, because if it were, it would be a reflection upon nine-tenths of the swine in the United States, which are "mongrel" or native-bred, and which, owing to the system and practice of American farmers, means no breed. If there had been more pride and interest manifested by American farmers in breeding one of the largest staples of food (and it seems remarkable that such has not been the case), we might have had a number of valuable local breeds suited to the climate and wants of special localities. The use of a mongrel sire, to obtain the best pigs for profit, is much more objectionable than that of a cross-bred. In a mongrel sire, there would be no fixed types or established characteristics desirable to transmit to his offspring. There would be a kind of indefiniteness and ability to root, an annoying activity, and a lankaess and meanness in form, which would be more likely to be developed in the offspring than any possible good traits which the animal might possess. The principle of original sin comes in here and will crop out, proving that superior qualities are *acquired*, and being somewhat *artificial, i. e.*, not exactly in the course of nature, but added by *extra* food and *extra* care, they will be overcome and obliterated by the characteristics which are more in harmony with a natural condition.

In all cases the sire should be thoroughbred, and most remarkable advancement or improvement may be made by using such upon mongrel dams. Any farmer who breeds a litter of pigs can well afford to pay for the use of such a sire, and any farmer who breeds several litters of pigs can well afford to own such a sire. I am fully persuaded that pigs bred as I have recommended can be grown and fattened with one-third less food than the ordinary mongrel stock, and, furthermore, when thus bred, combining the finer and coarser characteristics, the percentage of profit is at least one-fourth greater than otherwise. Farmers in my vicinity have become so convinced of these facts that it is almost a universal custom with them to follow the system which I have recommended.

A PERFECT TYPE.

While it is true that the small and excessively fat hogs are not desired in the market, it is also true that over-large and coarse-bred hogs are not so much in demand as they were years ago. For packing, a medium hog is required, and just such a one as would be produced by the line of crossing I have dwelt upon at length. In order to furnish a typical guide to farmers, as well as to breeders, a committee of experts was appointed at the National Swine Breeders' Convention, after an exhaustive discussion, to report "a general standard of excellence for a hog which shall best meet the requirements of the market." The standard adopted represents "a perfect hog most profitable to the farmer and consumer," and is above or outside of all breeds. It says:

"Such a hog must have a small, short head, heavy jowl, and thick, short neck; ear small, thin, and tolerably erect, but it is not objectionable if it droops slightly forward. He must be straight on the bottom from the neck back to flank, let well down to the knees in the brisket, and possess good length from head to tail. Back broad and slightly curved or arched from the shoulder to the setting on of the tail. Ribs rather barrel-shaped. Tail small. The hams should be long from the hock to the letting off at the loin, and be broad and full. Shoulders not too large, and yet sufficiently to give symmetry to the animal. Hair smooth and evenly set on. Skin soft and elastic to the touch. Legs short and small, well set under the body, and the space between them wide. A good depth between the bottom and top of carcass. He must be possessed of a good, quiet disposition, and, as a general rule, should not weigh more than three or four hundred pounds *gross* at twelve to eighteen months. Color may be black or white, or a mixture of the two. Such a hog will measure as many feet from the top of the head to the setting on of the tail as he does around the body, and as many inches around the leg below the knee as he does in feet in length or around the body, and the depth of the body will be four-fifths of the height."

"W. W. THRASHER,
"O. P. COBB,
"RANKIN BALDRIGE,
"*Committee.*"

The average weight in the above standard corresponds with the weight at which hogs are generally slaughtered at from twelve to eighteen months of age.

I am impressed with the fact that more hogs reaching this weight can be kept on the same amount of feed, which is now so wastefully fed by being trodden into the mud, if feeding platforms and warm sleeping places were provided. It is a common thing for pigs nine to ten months of age, in the Eastern States, to dress from 200 to 250 pounds. I suspect that with the kind of protection the average Western farmer gives his hogs, it takes all of the corn they can eat to produce enough heat in them to keep them alive, and hence the winter months are months of standing still,

or a period of no growth. They may truthfully say, "I have wintered so many hogs;" but they cannot say, "My corn crib is profitably changed into so much pork." Inbreeding should be avoided with pigs, as it rapidly deteriorates the blood and will speedily run out the best breeds. Defects will appear with three in-crosses, and constitutional weakness.

NATIONAL SWINE BREEDERS' CONVENTION.

The meeting of the National Swine Breeders' Convention, first in the spring at New York City and afterwards at Indianapolis, Ind., in the autumn of 1872, gave swine literature in America an inception which laid the foundation for an advancement greater than any of us had conceived, and has led to reforms and successes beyond what we could reasonably expect. Three associations have already been formed; the outgrowth of its recommendations for recording the pedigrees of thoroughbred swine, viz, Berkshire, Poland-China, and Small Yorkshire. The breeders of the Durocs, one of the old families of the Red Berkshires, have also agreed upon a standard of characteristics to mark true specimens of that breed. Several State swine breeders' associations have also been formed, with most beneficial results. Spurious breeders have fallen by the way, victims of the standards agreed upon by this convention, which standards embraced every family and breed known at the time in the United States. Rival breeders have united their efforts, not in antagonism, but in honest endeavor to push their respective breeds to greater success. The despised pig, which people ate regardless of its history or mode of life, has become more an object of interest, and every agricultural paper is now obliged to have its swine department to satisfy the demands of its wide-awake readers.

Breeding pigs has assumed a prominence commensurate with its importance as an extensive national industry, and the methods of rearing and fattening swine have attracted the attention of men who are interested in the welfare of the country. And impressed with the necessity of making this great staple of human food as perfect as possible, it has reached a dignity parallel to that of other animal industries, and is worthy of the thought, skill and energies of our most intelligent and enterprising citizens.

A DELEGATE. I rise to enter my most solemn protest against the assertion made by the gentleman from New York that the so-called hog cholera is produced by eating corn. I do not propose any controversy here or elsewhere, but I deny the assertion and insist upon proof. I have lived at the West for the last twenty-eight years, and have seen as much corn fed, and fed as much myself, as most men. I never saw a hog injured by feeding corn, nor any disease produced by it. I have seen a good many starve to death for want of it.

The CHAIR. We have now two papers, one by Dr. Stetson and one by Dr. Gurler, and probably the Convention would prefer to listen to these papers now. After these papers from the gentlemen who breed and fatten swine in the West are read, we can have our discussion if desired.

Mr. Gurler then presented the following paper:

EXPERIMENTS IN SWINE BREEDING.

By H. B. GURLER, *of Illinois.*

My paper will consist mainly of my own experiments.

I have had some experience with different breeds, but have handled and raised mostly the Poland-Chinas: they are the favorite breed in my section of the country. I have raised some Berkshires and a few Essex, also some Chester Whites. I prefer a black hog to a white one; the black pigs are less liable to get injured by the sun and mud than the white ones. I think care and skill in the management is much more important than the breed.

I will first give my experiments with skim-milk:

October 14, 1871.—Two pigs weighed 52 pounds and 62 pounds; total, 114 pounds. October 21, the two pigs weighed 60 pounds and 74 pounds; total, 134 pounds—a gain of 20 pounds in one week. They were fed 320 pounds of skimmed milk, making 1 pound increase from 16 pounds of skimmed milk.

These pigs were grade Berkshires, and had been on an exclusive milk ration previous to commencing the experiment.

March 15, 1875.—Weighed two lots of pigs, thirteen in each lot; one lot to be fed on corn and water and the other on corn and milk.

The lot fed corn and water made 8 pounds increase from one bushel (73 pounds ear) of corn.

The lot fed corn and milk, after allowing the same for the corn that it made in the above experiment and crediting the milk with the balance of the increase, makes one pound increase for every 16 pounds of milk. This was the same as my first experiment, where the pigs had a whole milk ration.

I think the first experiment would have shown better results if the pigs had been fed some grain food, and the last one would have shown poorer results if the pigs had been on a whole milk ration. I have no doubt about the *best* results being obtained by feeding skimmed milk in connection with other food. These two experiments are the basis on which I establish the value of skimmed milk in the following experiments.

I always have stock at least one week on the food to be experimented with before I weigh to commence an experiment, because an experiment beginning with a change of feed is not reliable. The results of many of my first experiments were thrown away from this cause.

The stock should be weighed at the same time in the day and the same length of time from feeding and watering, at the beginning and close of the experiment.

December 6, 1873.—Twenty-two July and August pigs weighed 2,575 pounds; average weight, 117 pounds. December 13, following, the twenty-two pigs weighed 2,755 pounds, a gain of 180 pounds in seven days, or $1\frac{1}{6}$ pounds per pig per day. They were fed 420 pounds of skimmed milk. Allowing 16 pounds of milk to make 1 pound increase, would make 26 pounds increase to credit the milk with, leaving 154 pounds to credit $11\frac{1}{3}$ bushels corn with—ear-corn, 75 pounds for 1 bushel—a gain of 13.84 pounds from each bushel of corn fed.

My experiments show that a bushel of corn (60 pounds) will make on an average 12 pounds live weight increase on swine. It also shows that 100 pounds of skimmed milk will make $6\frac{1}{4}$ pounds live weight increase. Now, in making some comparisons I should suppose 200 pounds of skimmed milk to equal one bushel (60 pounds) of shelled corn. Figuring on that basis, this lot of pigs consumed per day each 5.15 pounds of food, 4.4 per cent. of their live weight, requiring 4.44 pounds of food for 1 pound increase.

February 5, 1874.—Forty-six June, July, and August pigs weighed 9,220 pounds; average weight, 200 pounds. February 12, the forty-six pigs weighed 9,685 pounds, a gain of 465 pounds in seven days.

Gain per head in seven days, 10 pounds. Gain per head per day 1.44 pounds. They were fed $28\frac{1}{2}$ bushels ear-corn and 9 bushels of cooked corn-meal. Total, $37\frac{1}{2}$ bushels.

Gain per bushel, 12.4 pounds, live weight; consumed per day, 6.99 pounds of food, requiring 4.85 pounds food for 1 pound increase; consumed daily, $3\frac{1}{2}$ per cent., live weight.

June 17, 1874.—Twenty pigs weighed 3,145 pounds; on June 27 they weighed 3,320 pounds. Gain in ten days, 175 pounds. They were fed 1,160 pounds of corn, $19\frac{1}{3}$ bushels.

Gain per bushel, 9 pounds; gain per day each, $\frac{7}{8}$ pound. Food consumed per day each, 5.8 pounds; food for 1 pound increase, 6.62 pounds; consumed, 3.7 per cent. of live weight of food per day.

This lot were pure Berkshires, and had the range of a small pasture with white clover and timothy grasses.

January 25, 1875.—Thirty May and June pigs weighed 7,210 pounds; February 15 the thirty pigs weighed 7,900 pounds; gain in twenty-one days, 690 pounds; they were fed 4,393 pounds corn-meal dry; gain from 60 pounds meal, 9.42 pounds. They had water for drink, consumed 6.34 pounds of meal for 1 pound increase, consuming 7 pounds of food daily; consumed 2.9 per cent. of live weight of food per day.

The weather was extremely cold during this experiment, ranging from zero to 18° below every morning.

February 15, 1875.—The same thirty pigs were put on a shelled-corn ration. February 15 they weighed 7,900 pounds; on February 26 they weighed 8,200 pounds; gain in eleven days, 300 pounds; gain each per day, nine-tenths of 1 pound.

They were fed 1,848 pounds of shelled corn; gain from 60 pounds shelled corn, 9.74 pounds, requiring 6.16 pounds of corn for 1 pound increase. Consumed per day each, 5.57 pounds; consumed daily, 2.11 per cent. of live weight.

December 21, 1875.—Fifty-four pigs weighed 13,045 pounds; average weight, 242 pounds. Age, seven months. January 3, 1876, they weighed 13,730 pounds; gain in thirteen days, 685 pounds; gain each per day, .97 pound; they were fed $68\frac{3}{4}$ bushels ear-corn of 80 pounds; gain per bushel, 10.3 pounds; consumed each per day, 5.9 pounds; pounds of corn for 1 pound increase, 5.98; consumed per day, 2.43 per cent. of live weight.

January 3, 1876.—Fifty-four pigs weighed 13,730 pounds. February 4, fifty-four pigs weighed 15,089 pounds; gain in thirty-two days, 1,359 pounds; they were fed 168 bushels of corn; gain per bushel, 8 pounds; gain each per day, 8.10 pounds; con-

sumed each per day, 9 pounds; consumed 7½ pounds corn for 1 pound increase; consumed daily, 3.22 per cent. of live weight; average weight at beginning of experiment, 279.9 pounds.

November 1, 1876.—Thirty pigs weighed 2,765 pounds; November 15, they weighed 3,240 pounds; gain in fifteen days, 475 pounds; were fed 2,800 pounds skim-milk and 2,165 pounds ear-corn—28.8 bushels of 75 pounds. Allowing 100 pounds skim-milk to make 6¼ pounds increase, would make 175 pounds to credit the milk with and leave 300 pounds to credit the 28.8 bushels of corn with. Gain per bushel, 10.4 pounds; gain each per day, 1 pound; pounds food for 1 pound increase, 5.4; consumed per day, 5.7 pounds; consumed per day, 6.2 per cent. of live weight.

In September, 1877, I had thirty-four hogs from nine to fifteen months old that had been in pasture all summer with no corn or other grain feed, except the sows when raising pigs had corn and skim-milk. On September 1 I commenced to feed new corn, it being dented and glazed.

September 8, the thirty-four hogs weighed 7,130 pounds; October 4, they weighed 9,155 pounds; gain in twenty-six days, 2,025 pounds; gain per head in twenty-six days, 60 pounds; gain per head per day, 2.3 pounds. They still had the range of the hog pasture, with plenty of water for drink.

October 4, 1877, this lot of hogs were confined in comfortable quarters with a platform to feed on and were fed ear corn and water. They weighed October 4, 1877, 9,155 pounds; on October 17, 1877, 10,280; gain in thirteen days, 1,125 pounds; gain each per day, 2.54 pounds; gain from 80 pounds ear corn, 12⅔ pounds. They consumed each per day 12½ pounds shelled corn (80 pounds ear being equal to 60 shelled); food for 1 pound increase, 5 pounds; consumed per day, 4.64 per cent. of live weight.

October 4, 1877, thirty-one pigs weighed 3,160 pounds; October 16, these pigs weighed 3,760 pounds; gain in twelve days, 500 pounds. They were fed 600 pounds skim-milk and 35.6 bushels of corn (80 pounds ear). Allowing the milk to make 6¼ per 100 pounds, would make 37½ pounds to credit the milk with and leave 462½ pounds to redit the 35.6 bushels of corn with. Gain per bushel, 13 pounds; gain per day each, 1⅔ pounds; food consumed per day each, 6.2 pounds; food for 1 pound increase, 4.6 pounds; consumed per day, 6 per cent. of live weight.

October 6, 1877, fifty-eight July pigs weighed 3,154 pounds; October 25, these pigs weighed 4,255 pounds; gain in nineteen days, 1,101 pounds; gain each per day, 1 pound. They were fed 52½ bushels of corn, 9 bushels of corn and oats ground, and 2,880 pounds skim milk. Allowing the milk to make 6¼ pounds per 100 pounds would make 180 pounds to credit the milk with and leave 921 pounds to credit the 61½ bushels of feed and corn with, or 14.97 pounds per bushel. Consumed each per day, 4.13 pounds; requiring 4.13 to produce 1 pound increase. Consumed daily, 7.6 per cent. of live weight.

July 12, 1878, twenty-nine hogs weighed 4,790 pounds; July 29, these hogs weighed 5,250 pounds; gain in seventeen days, 465 pounds; gain each per day, 94 pounds; they were fed 42.3 bushels of corn of 60 pounds; gain per bushel, 11 pounds; consumed each per day, 5.15 pounds; consumed for each pound increase, 5.47 pounds; consumed each per day, 3.3 per cent. of live weight.

This lot were confined for fattening.

In 1878 I made a number of experiments with a litter of pigs, to learn at what age they would make the largest increase from the food. I made the first experiment with the sow and pigs when the pigs were twelve days old. The sow was a Berkshire and the boar an Essex. They were kept confined and did not have access to the ground. I had the entire care of them personally during all the experiments.

April 19, 1878, the sow weighed 290 pounds; eight pigs weighed 61 pounds; total weight, 351 pounds. April 27, the sow weighed 295 pounds; eight pigs weighed 112 pounds; total, 407 pounds; gain of pigs, 61 pounds; gain of sow, 5 pounds; total gain, 66 pounds. They were fed 530 pounds skim-milk and 141 pounds of corn meal and wheat bran. Crediting the milk at the rate of 6¼ pounds to 100 pounds would make 33 pounds increase from the milk and leave 33 pounds to credit the corn and bran with, making 14 pounds increase from 60 pounds feed. Pounds of feed required to make 1 pound increase, 4.54; consumed per day, 4¾ per cent. of live weight.

Figuring the milk at 25 cents per 100 pounds and the meal and bran at $10.50 per ton, would make the cost of feed as follows: 530 pounds milk at 25 cents, $1.32; 141 pounds feed at $10.50 per ton, 74 cents; total cost of feed, $2.06; total increase, 66 pounds; cost per pound of increase, 3.12 cents.

These figures show that 74 cents' worth of meal and bran produced as much pork as $1.32 worth of skim-milk. Feed was very cheap with us at that time.

The skim-milk I have put in at too high a price to compare with other feed at the time.

It is evident from the above figures that skim-milk was worth but 14 cents per 100 pounds when corn meal and wheat bran were worth $10.50 per ton. I think skim-milk fed to swine skillfully is worth one-half as much per 100 pounds as corn is worth per bushel.

June 8, the eight pigs weighed 327 pounds; June 21, the pigs weighed 423 pounds; gain in thirteen days, 96 pounds; they were fed 439 pounds skim-milk and 217 pounds corn. Crediting the milk with 6¼ pounds per 100 would make 27½ pounds increase, leaving 68½ pounds increase to credit the corn with; 3.61 bushels, or 19 pounds, increase from 60 pounds corn. Gained each per day, 0.9 pound; consumed each per day, 3.34 pounds; pounds food required for 1 pound increase, 3.7; consumed daily, 8⅐ per cent. of live weight. Average weight at beginning of experiment, 41 pounds.

Figuring the milk at 25 cents per 100 pounds and the corn at 30 cents per 60 pounds we have 439 pounds milk at 25 cents, $1.10; 217 pounds corn, $1.08; total cost of feed, $2.18, which produced 96 pounds of pork at a cost of 2.27 cents per pound, live weight.

Figuring the milk at one-half as much per 100 as corn was worth per bushel, the account would stand as follows: 439 pounds milk at 15 cents, $1.65; 217 pounds corn (at 60 pounds per bushel) = 3.61 bushels, at 30 cents, $1.08; total cost of feed, $1.73, to produce 96 pounds increase. Cost per pound, 1.8 cents.

August 15, 1878, the eight pigs weighed 925 pounds; August 24 they weighed 1,010 pounds. Gain in nine days, 85 pounds. They were fed 4½ bushels of corn and 271 pounds of skim-milk. Allowing the skim-milk to make 6¼ pounds to the 100 would make 17 pounds to credit the milk with and leave 68 pounds to credit the 4½ bushels of corn with, or 15⅑ pounds per bushel of 60 pounds shelled corn. Gain each per day, 1.2 pounds; consumed each per day, 4 87 pounds; consumed for 1 pound increase, 4 pounds; consumed per day, 4.2 per cent. of live weight.

July 23, 1879, twenty-four sows two years old had been at pasture with what dry corn they would eat. They weighed 8,740 pounds. On August 5 they weighed 9,320 pounds; gain in thirteen days, 580 pounds. They were fed 49½ bushels of shelled corn (60 pounds per bushel). Gain per bushel, 11¾ pounds; gain each per day, 1.86 pounds; consumed each per day, 9½ pounds; for 1 pound increase, 5.1 pounds; consumed per day, 2.6 per cent. of live weight; weight at beginning of experiment, 364 pounds.

I wish to make one comparison of pigs against calves, and I will take the most successful experiment with each to compare.

February 22, 1881, two grade Durham calves, about five months old, at 9 o'clock a. m., with no feed in morning except hay, weighed 355 and 377 pounds; total, 732 pounds. March 1, at 9 a. m., with no feed except hay, they weighed 372 and 395 pounds; total, 767 pounds; a gain of 35 pounds in seven days. Gain each per day, 2½ pounds. They were fed 280 pounds skim-milk, 44 pounds of corn meal, and 70 pounds of hay. I will figure the milk at 25 cents per 100 pounds, the same as with the last pig experiment, and the account will stand thus:

280 pounds skim milk at 25 cents	$0.70
44 pounds corn meal at 30 cents per bushel and grinding	25
70 pounds hay at $10 per ton	35
Total cost of 35 pounds increase	1.30

Cost per pound, 3.7 cents, to compare with 2.27 cents, cost of pork in my best experiment.

I will now reduce the calves' feed all to corn to compare with the pigs':

	Pounds.
280 pounds milk, equal corn	84
70 pounds hay, equal corn	45
Corn meal	44
Total feed reduced to corn	173

For reducing hay to corn I have used a table on page 105 in Willard's Dairy Work, which puts 100 pounds of hay equal to 64 pounds of corn.

It required 5 pounds of food to produce 1 pound increase with the calves, and 3.7 pounds with the pigs.

The calves consumed daily 3⅓ per cent. of their live weight. The pigs consumed daily 8⅐ per cent. of their live weight.

I think these calves made good growth, and that rate of growth would make them weigh 1,000 pounds at one year of age. The calves weighed, April 9, 920 pounds, an increase of 188 pounds in forty-seven days, or 2 pounds each per day. They were sold to a butcher April 14 and drawn 4 miles before being weighed—weight, 935 pounds—and sold for 4½ cents per pound, or $21 each. They had no new milk after they were four days old.

From this table we learn that the pigs making the largest increase from the feed were two months old. They weighed 41 pounds each, and were fed corn and milk. Time of experiment, month of June. The experiment was No. 14.

The second best results were from No. 15, in the month of August. Average weight, 115 pounds; age, four months. They were fed corn and skim-milk.

The third in results is No. 11, in the month of October. Average weight, 54 pounds; age, two and a half months; feed, corn and milk and corn and oat meal.

The fourth in results is No. 13. A sow with eight pigs twelve days old were fed corn, meal, wheat bran, and skim-milk in the month of April.

The fifth in results is No. 1, in the month of December. Average weight, 117 pounds; age, four months; feed, corn and milk.

The sixth in results is No. 9, in the month of October. Average weight, 102 pounds; feed, corn and milk.

The seventh in results is No. 10, in the month of October. Weight 269 pounds; age, thirteen months; feed, corn.

If my work proves anything, it proves that a pig will produce more increase from the same amount of food than an old hog, and that warm weather is more favorable to pork-making than cold weather. I have never made more than two experiments in warm weather that produced less than 10 pounds increase from 60 pounds corn. An average of the sixteen experiments shows 12.13 pounds live-weight increase from 60 pounds of corn.

I have no doubt that better results might have been reached in many of my experiments if I had separated the lots and had five to ten in a lot, but when one has from one hundred to two hundred pigs on a farm, it makes much more work to care for them.

In the experiments where milk was fed with the corn, I have allowed $6\frac{1}{4}$ pounds increase for 100 pounds skim-milk, and credited the corn with the balance of the increase.

In figuring the amount of food consumed, I have reduced the milk to corn, calling 200 pounds of milk equal to 1 bushel of corn.

I am well satisfied that with proper food and care, the first 100 pounds growth on a pig costs less than the second, and that each succeeding 100 pounds costs more than the preceding one, other influences being the same. One point I wish to speak of the second time is, that all stock should become accustomed to any change of food or surroundings before commencing an experiment.

About 14 years ago I bought a feed-steamer and used it three years, cooking at times a part of the food for my hogs, and in some instances all the food. At the end of three years I stored it away, and it is stored away now.

Experiments Nos. 4 and 5 were with the same lot of pigs. No. 5 is really a continuation of No. 4.

Experiments Nos. 6 and 7 were also with the same lot of pigs, and could have been put together as one making. The one experiment covers forty-five days.

This work was all done for my own information, and I have tried to have it reliable. But little of it has ever been published.

The following is the table of experiments:

No. of experiments.	Month.	Year.	Average weight.	Age.	Gain per bushel of 60 pounds.	Gain per day.	Food consumed per day.	Food for 1 pound growth.	Percentage of live weight consumed daily.	What feed.
				Months.						
1	December.	1873	117	4	13.84	$1\frac{1}{6}$	5.15	4.44	.044	Corn and milk.
2	February	1874	200	7	12.4	1.44	6.99	4.85	.035	Corn and cooked meal.
3	June.....	1874	157	.....	9	$\frac{7}{8}$	5.8	6.62	.037	Corn soaked.
4	January ..	1875	240	8	9.42	1.1	5.76	6.34	.029	Dry corn meal.
5	February	1875	263	9	9.74	9.10	5.57	6.16	0211	Corn.
6	December.	1875	242	7	10.3	.97	5.9	5.98	.0243	Corn.
7	January ..	1876	250	7	8	8.10	9	$7\frac{1}{2}$	.0322	Corn.
8	November	1876	92	.....	10.4	1	5.4	5.4	.062	Corn and milk.
9	October...	1877	102	.....	13	$1\frac{1}{3}$	6.2	4.6	.06	Corn and milk.
10	October...	1877	269	13	$12\frac{1}{5}$	2.54	$12\frac{1}{2}$	5	.0464	Corn.
11	October...	1877	54	$2\frac{1}{2}$	14.97	1	4.13	4.13	.076	Corn and milk; corn and oat meal.
12	July.....	1878	165	.....	11	94	5.15	5.47	.033	Corn.
13*	April.....	1878	.....	.....	14	.....	.....	4.74	.047	Wheat bran and milk; corn meal.
14	June.....	1878	41	2	19	$\frac{9}{10}$	3.34	3.7	.08$\frac{1}{2}$	Corn and milk.
15	August...	1878	115	4	$15\frac{5}{9}$	1.2	4.87	4	.042	Corn and milk.
16	July.....	1879	364	.....	$11\frac{3}{4}$	1.86	$9\frac{1}{2}$	5.1	.026	Corn.

* Sow with eight pigs twelve days old.

General CURTIS. I will ask the question, whether or not this mash which you feed is of milk and meal, or water and meal, and whether the milk was sour?

Mr. GURLER. I never took any pains to sour it. If I mixed up more than they could eat at one time it remained in the barrel. I used to skim the milk in the mornings, and that milk was fed to the pigs. If the milk was sour they got it sour.

The CHAIR. Our next paper is from Dr. Stetson, of Illinois. It is a common expression all through the West that Dr. Stetson knows how to breed good hogs.

Dr. STETSON. It is a long way from the blarney stone here, and I would say that I am laboring under a slight attack of too much terrapin. I may be obliged to read in my chair, but I think I can speak loudly enough so that all may hear, but my legs might give out.

SWINE-BREEDING.

By Dr. EZRA STETSON, *of Illinois.*

An old man, upon whose head the snows of seventy winters have descended, has been requested by our worthy Commissioner of Agriculture to tell you what he knows about swine-raising at the West. Why the lot has fallen to me I can hardly guess, unless it be that I am a Yankee and entitled to write "M. D." after my name.

Gray hairs are no evidence of wisdom, and that man has lived in vain who has not corrected the errors and mistakes of his youth by the light of experience. True wisdom consists in leaving the false and seeking for the truth.

Born and raised upon a farm, a citizen of the West for the past forty-five years, the last twenty-eight of which have been solely engaged in agriculture and the breeding and rearing our domestic animals, of which swine have been the chief factor, I bring age with experience enough to know that I have hardly begun an education, much less finished it, and can truly exclaim that the things that are known are but as a drop in the bucket to the unknown. I am a scholar rather than a teacher, but such lessons as I have learned in the school of experience I am ready to recite.

Naturalists, until a very recent time, supposed and taught that all our different breeds or variations of swine were the descendants of a common ancestry, the *Sus aper*, or wild boar, not yet extinct, and may be seen in the zoological gardens of the Old World. For how long a period of time the hog has been domesticated, history gives us no information. That swine were unclean animals to the ancient Egyptians and Jews, we have abundant proof. As the nations of the earth increased their knowledge of breeding by selection as well as by keep, the hog was elevated to a much more useful animal than the wild boar. Then began the distinct or subvarieties of breeds. At the close of the last century about every shire or county of England could boast its breed of swine, but all these breeds had a common parentage. The fact that at the time of its discovery America was without a hog, may not be generally known. As a consequence, all swine in America are either imported or the descendants of former importations, and until about a century since all the swine in America were the descendants of the wild boar. Some of these breeds were probably better than others, but still at this day would be curiosities rather than useful animals.

When and by whom the swine of China and Siam were taken to Europe, I have not been able to determine. These cross-bred swine were soon found to give early maturity, with an inclination to take on fat, coupled with a more quiet disposition, such as the old breeds did not possess. The earliest named cross was made by the Duke of Bedford, and called Woburn. This is interesting to us, as a pair of these pigs were sent by the Duke as a present to General Washington who, however, failed to receive them. Some of the descendants of the Woburns found their way to New England, which did very much to enhance the value of their swine.

Since the crossing of the swine of China with the then existing breeds of English hogs they have taken the name of "improved," as the improved Yorkshire, improved Berkshire, and so running through all their shires. So well is the *improved* breeding generally understood in England that, at their agricultural shows, premiums are only awarded to four classes, large, and small black, and large and small white. Now, all these breeds get their improvement from having been crossed with the Chinese or Siamese swine.

And now comes Nathusius, a German naturalist, who teaches that there has once existed a distinct species of swine, which he has named *Sus indicus*, and that the descendants of the *Sus indicus* are to be found in the present swine or China and Siam. This makes them a distinct species, and not a mere variety or breed. Of one thing we are fully assured, that since commingling the blood of the Oriental species with the descendants of the wild boar, breeders of swine have made as many breeds or varieties as they choose, and all of them possess excellencies that did not formerly exist.

All intelligent breeders know how easy it is at this time to mold the size, color, as well as the fattening qualities of our swine. *Eureka!* From the *Sus indicus* we get the streak of *fat*, and from the *Sus aper* the streak of *lean*. The blending of the blood of these two distinct species has revolutionized the swine of our day, as well as the market for their products.

And now for the hog of the West. He must be black, or very nearly so in color to present anything like a cleanly appearance, as well as to guard against mange or other diseases of the skin, which are inseparable from our climate. He must also be well coated with hair to withstand the rigors of our latitude. They should have hardiness of constitution, with an aptitude to take on flesh and fat at any age.

Furthermore they should possess a peaceable and quiet disposition. Even a hog has a disposition, and breed out as many *devils* as we may, a hog he is, and a hog he always will remain.

Allow me a few words on the different breeds that have been tried in the West. All of the improved white hogs of England have had their advocates, and been thoroughly tried and discussed. The same may be said of the white breeds alleged to have originated in America, as the Chester Whites, of Pennsylvania and the Victorias, of Indiana. The Jefferson County hog, of New York, is simply the improved Cheshire of England. All of these have had their day, but cut no figure at our great packing establishments. The English black breeds, notably the improved Essex and Berkshire, have been widely disseminated and found hearty admirers. All mankind are lovers of the symmetrical and when well bred as well as fed, the Berkshire is the beau ideal of the *esthetic* (no illusion to Oscar Wilde) swine fancier. Stripped of two of their most objectionable features, this breed of swine would stand at the head of *hogdom*. Their restless disposition and proneness to reversion is known and acknowledged by all who have proved them, unless it be parties who laud them for sinister purposes. We all remember Peter Pindar's razors that were only made to sell, and these not on the open market. The Berkshire was improved by crossing with the Essex, and the Essex improved by crossing with the Neapolitan, and the Neapolitan in turn with the Turkish. Unless most carefully bred as well as fed, it takes but a few generations to revert to the Neapolitan, with no *hair* and no *wool*, and the disposition of the Grand Turk never has been nor can be eradicated. America has on its Atlantic border a little State, fossiliferous if not fossil, that is now trying to come to the fore with its red hogs. These are genuine descendants of the old Lumworth or Berkshire of a time long ago. No claim ever has been or can be made that this breed has been improved, which can only be done by extermination. They are a relic of a bygone age, and an exemplification of the old proverb, "History repeats itself." In my boyhood these hogs were not uncommon, and now look to me like an untimely resurrection.

The swine of the West at the present time are made up of a very large per cent.—and it is reasonable to predict of the future also—of a breed now known as the Poland-China, a name as uncouth and outlandish as can be well imagined. If, as the poet tells us, "a rose by any other name would smell as sweet," surely a hog is none the worse by calling him a bad name. In the light of modern science, as well as practical swine-growing, the origin of this breed is perfectly plain and easy to understand. At the beginning of this century the inhabitants of the fertile valley of the Ohio and its tributaries found they could raise corn (maize) in such vast quantities and with so little labor, they set themselves to work on a new factor for the utilization of their surplus corn. The converting of this corn into whisky and drinking the whisky was not in consonance with the principles or religious tenets of a community of Shakers settled on the Miami at Union Village, Butler County, Ohio. So early as 1815, a hog known by them as the "Big China" was taken by them from Philadelphia and crossed on their then existing breeds. This is the first evidence we have of the *Sus indicus* blood being taken west of the Allegheny Mountains. About this period, and still later, Cincinnati was known all over the world as Porkopolis. This gave an impetus to the swine-grower to find swine that would make the most pounds of pork for the bushel of corn consumed. It was soon learned that the Butler County hog, as originally named, was the hog that filled the bill. I am free to confess that the Butler County hog was formed in the dark, and without any fixed principles of breeding. By patience and perservance the foundation was laid for a breed of swine that have revolutionized the whole business of swine-growing in the West, as well as adding untold millions to the wealth of the nation. It makes no difference to the present grower and breeder how many of the different breeds of swine that were the descendants of *Sus aper*, mixed up in a heterogeneous mass, that were originally used as a stock upon which was engrafted the blood of the *Sus indicus*. It was the blood of the "heathen Chinee" that alone has wrought this marvelous change in the usefulness of the so called Poland-China swine. It has taken a great many generations to establish this result, and at this time the breed is well established as any.

Furthermore, there are no letters patent granted to any individual breeder. They are bred in countless millions all over the great West, and every breeder exercises

his own taste and judgment in regard to size, form, and color. That they have Chinese blood in their veins is patent to every intelligent observer, and this blood is of so distinctive a type, it is impossible for them to revert to the Poland, Russian or any of the unimproved breeds descended from the *Sus aper*. As the foundations of the Poland-Chinas were laid by the Shakers, it is but common justice that they should have been named the Shaker hog. Hail to the memory of the Shakers of Union Village, Ohio!

No more true and appropriate eulogy of the Poland-China swine has been or can be written than that from the pen of the Hon. John M. Milliken, of Hamilton, Ohio, who had also known and been familiar with this breed from its infancy. Hear him: "The friends of the Poland-Chinas feel fully assured that their favorite breed *possesses more good qualities than are to be found in any other breed.* For fecundity, for rapid growth, good size, early maturity, aptitude to fatten at any age, vigor of constitution, quality of meat, neither too fat nor too muscular, fixedness of character, and for giving to the farmer a larger amount of choice meat and lard for the food consumed than any other breed, the friends and breeders of the Poland-China swine believe them to be superior to all other breeds of improved swine."

This eulogy I fully indorse, having bred them by the thousands in the past fifteen years or more. Furthermore, previous to this time I had experimented with about all the so-called improved swine, and for the matter of dollars and cents discarded them all. They had been weighed in the balance and found wanting. I shall experiment no more, but when my neighbors find a more profitable hog than the Poland-China, I hope to retain enough of good sense to move with the world.

As to the market value of the Poland-Chinas compared with other breeds, I cannot answer any better than was replied to me very recently. The statistician of two of the largest packing-houses in Chicago, if not of the world, paid me a professional visit to take the *census* of the swine in marketable condition as well as the prospective hog crop of the near future. Knowing this gentleman to be fully posted as to the money value of our different breeds of swine, I took the liberty to ask him which breed of hogs the packers preferred. His answer was couched in the language of diplomacy: "The Poland-China is as good as any."

The CHAIR. The whole question of swine breeding and feeding is now open for discussion for a short time.

Col. F. D. CURTIS, of New York. A gentleman entered a solemn protest at the close of my remarks, against something I did not say. What I did say was, that the excessive feeding of corn produced disease of the stomach, and that might prevail in a large way and to such extent as to *seem* contagious, and so make an appearance of cholera, whereas it was a disease of the stomach. I do not say this as a mere matter of theory or opinion, because I have taken out of my own pens a number of pigs that have laid down and died from eating corn, and when I examined them I found the cause to be acute inflammation of the bowels. They would eat at night and be dead in the morning. Of course, I might have called it "hog cholera," and let it go at that, but I made a careful examination of the conditions and found it was nothing in the world but inflammation of the bowels. Now, if there were a hundred cases, when I really had but one, of course there would have been a corresponding mortality, and I might have termed it "hog cholera," whereas it proceeded from natural causes.

Mr. COFFIN. Suppose those hogs, instead of being shut up, were out in a large clover field, and some morning you found a dozen or two dead?

Col. F. D. CURTIS. I could not tell the cause of death without examination. I am aware, Mr. President, that this matter has been thoroughly examined, and that startling facts have been stated in connection with it. In some instances great mortality has existed among hogs that had a large run, and I am not prepared to explain the reason. I know there has been a great deal of mystery about it, but I am satisfied that an excessive corn diet is injurious to hogs, especially to young pigs. Another case in illustration: I had a pen of pigs last fall that I shut up and commenced to feed corn. Those pigs began to sicken, and I

think all would have died in a little while, but I turned them out and fed them nothing for a number of days. I allowed them to follow their own instincts, and every one of them recovered. I thought I had made what seemed to me to be an important discovery. I had shut them up for the purpose of weaning. After they had run out for some length of time I returned to corn, and found they could eat it, and they gained rapidly and kept in perfectly healthy condition. I must insist, gentlemen, that it is a great wrong to shut up pigs and feed them on corn.

Gen. N. M. CURTIS, of New York. Shelled corn would be less injurious than meal?

Col. F. D. CURTIS, of New York. Yes, because they would not eat so much.

The PRESIDENT. In the annual report of the Department for 1881–82 is an elaborate essay on hog cholera by Dr. Detmers. I think it would be a good idea to lay certain references in this article before the practical men here, and see how their experience agrees with the conclusions of these scientific investigators. There is no doubt that this disease is a destructive one, and one about which we understand very little. I think I can give some points out of this report that will prove interesting to the Convention. As I am compelled to leave now, I will say that there are papers remaining on cattle and sheep husbandry to be read to-morrow, and a paper by Mr. Baker, of Kansas, on forestry. I think the paper on sheep had better be considered, and that this question of scientific investigation into hog cholera be laid before the practical men later. I say this because I am obliged to leave now, and I want the Convention to understand the first business in the morning.

Colonel BEVERLY, of Virginia. I listened with great pleasure to the essay of Mr. Curtis, but I must take issue with him in regard to corn producing hog cholera ——

Col. F. D. CURTIS, of New York. I do not say it does.

Colonel BEVERLY, of Virginia. Now, in our section of country, we feed all the corn we have to our cattle, and the hog lives on anything he can get. It is "root hog or die" with him. [Laughter.] Two years ago that disease prevailed as an epidemic. One peculiarity was, that it traveled in a southeasterly direction, and was two years in passing across the State of Virginia. When it passed over me, my hogs had not seen a grain of corn, and I lost every one taken. No possible correctives that we could think of or bring to bear seemed to stop it for a moment. It passed over, and in six months we were as clear of it as we are to-day. I lost 300 or 400 hogs. It was in the summer time, when we do not use corn, and those pigs had never seen a grain of corn.

Professor KNAPP, of Iowa. I bred hogs practically for quite a number of years, and tested to quite an extent this question of hog cholera. I emphatically indorse what Colonel Curtis has said on this subject. There is a difference in the understanding of Mr. Stetson and myself as to what Colonel Curtis did say. I did not understand him to assert that corn produced hog cholera, nor do I wish to take that position myself. But I do say that a gorged system may not only induce in an animal but produce in the offspring such a condition that the animal, in its weakened state, is more susceptible to disease as it passes along than an animal not fed and bred in that way, and this I have tested in more than three thousand cases.

Mr. COFFIN, of Iowa. Susceptible to the disease, as it passes along?

Professor KNAPP. Yes, sir.

Mr. COFFIN. Where is the seat of that disease?

Professor KNAPP. That is not my proposition. I do not assert that

corn induces it. Understand me; I do not say that corn is the cause of hog cholera. The simple proposition is this: It may induce a condition in the hog that renders it more susceptible to any disease, because hog cholera means a good many things. I recall typhoid pneumonia, for instance, where it seemed to originate from just the condition that Colonel Curtis supposes—lying in heaps upon heaps of manure. I am so well satisfied of this that I do not allow a shovelful of the excreta of swine to remain in or about the pen. I could name hundreds of instances where animals so situated have resisted the cholera, when every other animal was swept by it. I could name prominent gentlemen all through the West by whom these statements could be verified. I can cite more than 100 cases when I have been sent for to advise with reference to hog cholera, and where it was sweeping the whole hog kingdom. If it induces this condition, and this condition can be propagated, as I know to be the case from experiments, the swine are just as liable to be swept if they were on pasture, and had no corn, provided it was in the breeding. A gentleman says he breeded in such and such a way I wish to ask him where he gets his male? What is the boar, and has he not brought with him conditions which induced his offspring to take on disease? Every one knows there is that "piggishness" about the hog which causes him to desire to consume more than he can get away with. In every case where the swine plague has attacked animals kept in a proper manner, we have been able to arrest the disease, and it did little damage. I could name herds where they lost only 5 per cent. The animals were sick, but their vigor of constitution and great vitality carried them through, and this was not because of any new discovery of scientific principles, but is based upon laws applicable to the human family. It is not that corn produces the disease. I believe that corn is just as healthful as other things; but it can be so gorged as to produce disorder. It is true, corn is palatable to the swine, and they are apt to eat more than is good for them. If they are freed from hog cholera, it will not be from the bugbearing of scientific men over the deductions of science, but rather from the hard sense of those who propose such things as Colonel Curtis has suggested on this floor. No man is prepared to say yet whether the bacteria in the system is the cause or effect.

Colonel CURTIS, of New York. Mr. President, while Professor Knapp was so lucidly, clearly and satisfactorily, to myself at least, putting his point, it occurred to me that if hog cholera is simply a sweeping plague or infection without any natural cause, why is it that we have not had it sweeping through the State of New York, where we have a different system of keeping and feeding swine, and where they are generally kept on very short rations? We have never had any hog cholera in New York, except in one instance. A gentleman who kept a large hotel in Saratoga Springs during the summer purchased a lot of hogs, and poured into them a mess of fermented, putrid stuff, with which they gorged themselves. Pretty soon they commenced to die off, and that is the only case I ever heard of in the State of New York. Now, if this be a great, sweeping plague that comes on the winds, why has it not swept all over the State of New York? Simply because our hogs have been in a condition to resist it, and therefore we have never had it. But I took the trouble to write to a distinguished gentleman in the West, asking him the definite, practical questions whether there was less hog cholera in the West than formerly, and if better care prevailed in the treatment of hogs? He answered these questions in such a way that I have based my remarks upon his statement, coupled with my own

judgment, my own observations and my own experience, and I think history will sustain me in their correctness. As Professor Knapp has indicated, if men treated their hogs as they would treat themselves, by subjecting their hogs to the same hygienic laws and the simple principles of common sense and physiology, we would have less hog cholera, and in a little while have none at all. But if they pursue the system that has been followed in the West so generally heretofore, it will be a disease that will continue. The matter, in my judgment, rests not with the development and examination of science, but with the common sense and practice of the people themselves.

Dr. ELLZEY, of Virginia. In regard to this matter of hog cholera, it is a specific contagion which may be and has been put in bottles and carried about. It may be injected into the blood of any swine which have never had the disease, and it will produce it.

Colonel CURTIS. Will you permit me to ask a question right here? If your statement be correct, why is it that in the State of New York, which is traversed every day for 500 miles by hundreds of Western swine coming through in open cars, that we have not had that disease?

Dr. ELLZEY. It is a true statement; but why cholera has not prevailed in the State of New York depends upon causes which I have never investigated nor had any knowledge of.

No process of feeding can fortify a system against the infection of hog cholera any more than a particular regimen of dieting, if your reference is to corn meal, can fortify a man's system against the specific contagion of the small-pox. When hog cholera does prevail, it will make its own selection of swine. I have lived in the midst of it and suffered its losses, and when it takes the swine of the neighborhood, it sweeps all before it. I have lost forty in twenty-four hours, and it is apparent that it attacks native swine with especial vehemence. It attacks the common scrub swine, the so-called "fiddle face," which is the very reverse of engorgement, either in breeding or feeding, and sweeps them off with greater certainty than any other, as well as the swine we have in pens, well-fed, well fatted and in healthy condition to resist the contagion, apparently better than those out on the range.

What sort of people are subject to these epidemics of small-pox and the like? Are they not your exhausted troops and armies, or is it the full-fed and well-cared-for people of populous rural districts? It is the starvelings who are forced to go in crowds and in camps, and become scorbutic and run down.

The cause of the hog cholera is a specific contagion which has been bottled up, carried about and inoculated, and which is cultivated. I know nothing of the origin of small-pox, but I do know that vaccine will keep a man from having it, and I also know that if you take the virus which produces hog cholera and inoculate a hog it will protect him, and that corn has nothing more to do with it than with the epidemic of small-pox. It is a specific contagion, and will attack a territory, do all we may, the fat and the lean, as well those hogs in pens and sties as those which are not. In point of fact, it has swept the mountain ranges of North Carolina, and is continually abroad in the Southern States, killing the hogs out on the ranges, and often attacking the wild hogs. It will take off any kind of swine. It has been inoculated upon the same system you inoculate for smallpox, or for the anthrax, as Pasteur has so successfully done, and even recently for hydrophobia. Yet he does not know whence hydrophobia originated. Who knows where the first mad dog came from? What difference does it

make, provided a man can be prevented from having this disease? That is what Pasteur has demonstrated to the French Academy, and his results cannot be called in question.

The CHAIR. Probably the practical question is, whether the kind of keeping which Colonel Curtis shadows forth would be a help against that, or does the Western way of keeping induce it?

Dr. ELLZEY. It will neither help nor hinder. It will attack, I assert, the healthy and the sick, and the contagion is found to pass for miles through the purest atmosphere, attacking a hog that may have the finest hygenic surroundings and daily treatment. It will kill him as quick as one out on the ranges, and false ideas and false opinions about this disease are hurtful. For this reason I occupy the time of the Convention, since these errors do an enormous amount of damage among the less intelligent farmers. With regard to hog cholera, the proper process is to stamp it out, and there is no other successful treatment.

Professor KNAPP. I wish to make just one statement; it is a question of fact and observation, and not of assertion, and the fact and the observations in a great many thousand swine controverted the position taken. I have no question of that.

Dr. STETSON, of Illinois. I am neither learned nor wise. I have a little experience, though, and have been raising hogs for nearly thirty years, in large numbers. I have suffered pecuniary losses from this disease called hog cholera. My attention has been called to it, not only as a physician, but as a patient. I have been a sufferer by the disease originating among the weaklings of my herd, among the little ones, and I have had an opportunity to observe its outbreaks in a great many other instances. My idea of it is, as the gentleman from Virginia has said, that it is a specific disease and, like other specific diseases, had a beginning. It may originate *de novo*, but the cause of its origin, of course I do not know. My own theory is, that it originates from the same cause that produces ship fever or typhus fever among men. It is the bringing a large number of swine together; in other words, to use a common expression in America, we breed the disease. I think the disease originates in this way.

At this point the Convention adjourned until to-morrow (Saturday) morning at 10 o'clock.

FIFTH DAY.

SATURDAY MORNING, *January* 27, 1883.

The Convention was called to order at 10.30 a. m.

The PRESIDENT. I shall ask the indulgence of the Convention while I lay before it certain statements of Dr. Detmers with regard to hog cholera. The question was under discussion last evening when we adjourned, and gentlemen will remember that I told the Convention I would look over his report of this year, and see what was in it bearing upon the cause and the mode of managing, and perhaps the remedy, if there be any. I will now lay the matter before the Convention in a condensed way, by reading extracts from Dr. Detmers' report. I do so for two reasons: first, because practical men are here, and next, because the extracts which I shall quote will naturally appear in the report of this Convention. I think this condensed form is more likely to be read than when surrounded by a mass of scientific phraseology. We do not thoroughly understand all these scientific terms, but they do, and it is

a matter of interest to Dr. Detmers and Dr. Salmon, who are engaged in this business, to decide what is the cause of this disease.

In the first place, Dr. Detmers says:

The swine-plague Schizophytes or Microbes, in their development and propagation, pass through certain forms, or metamorphoses. The most simple and common form, that of a spherical micrococcus, is followed by that of a zoogloea mass or coccoglia, in which a large number of micrococci are kept together in one mass by being imbedded in an apparently viscous substance—the glia. While yet in this glia a further development takes place; the single micrococci commence to grow—grow endwise—and become double, till finally the glia breaks and the micrococci, most of them already double, become free. The latter, however, keep on growing or doubling endwise till chains of various lengths are formed. These latter soon break up into shorter ones, or joints, and finally, at least some of these joints develop a lasting spore—are changed into a helobacterium—and the lasting spores, it seems, produce the germs of new micrococci. The swine-plague Schizophytes or Microbes, although possessing great vitality, being almost indestructible by either high or low temperature while in the state of helobacteria or lasting spores, are easily destroyed when in the form of double micrococci or micrococcus chains.

After describing these spores, he says:

It was also observed that frost or a temperature sufficiently low to prevent or to arrest putrefaction is unfavorable to and even arrests the development and propagation of the swine-plague germ, and keeps it in a dormant state until, if continued for a long time, it destroys its vitality, or at any rate its power to produce mischief.

He further says:

Last winter was a severe one. The cold was intense and lasting (that was in the winter of 1880), and the snow, at least here in the West, covered the ground for a long time and to a considerable depth. This interfered with the development of those Schizophytes outside of the body of the animal.

This is important, because the doctor believes he has discovered by the use of the microscope that this is the cause of disease. The animal takes into his stomach a certain organized vitalized body, which is called a spore in science, and which he calls a germ and one or two other scientific names—that is, an actual organic living thing, outsideof the animal, which, as he says—

Were not especially protected by clinging to moist and porous bodies, such as are poor conductors of heat, and at the same time admit just enough air to supply the wants of the Schizophytes. The severe winter, therefore, kept most of these germs outside of the body of a hog in a dormant condition, prevented their change from one state to another, and impaired in that way their vitality until they finally became destroyed. It also happened that when cold weather set in last winter most of the existing cases of swine-plague were of a comparatively mild type, or much less malignant than in 1878–'79, as has been explained in my former reports.

Further, at the end of the winter, when the snow melted, a large portion of the whole surface of the land became submerged, and all the streams, big and little, were not only running to their full capacity, but were overflowing their banks; therefore, it is probable that most of the Schizophytes which happened to be yet alive on the surface of hog-yards, pastures, &c., were washed away or carried off by the numerous streamlets into creeks and rivers before they could undergo the changes necessary to produce germs and micrococci able to ascend into the air with the aqueous vapors and to come down again with the rain or dew. When the high water subsided several pouring rains occurred, which again flooded the land and undoubtedly washed away a good many of the germs which remained on higher land, and which had not been carried off by the inundations caused by the melting of the snow. Besides, the spring was cold and backward, and thus natural causes retarded the development of everything organic, and the Schizophytes which so far had escaped destruction but had remained in a dormant state for a long time could not have been expected to make rapid and vigorous changes from one state to another. In order to develop and to undergo the changes necessary to propagation they not only need a certain degree of warmth and moisture, but also a change of pabulum, and probably of place after a certain cycle of metamorphoses and propagation has been completed. If that cycle is completed, and new pabulum or a change of place is not provided, they become sterile and sink into a dormant state, and no metamorphoses and propagation take place.

According to my observations in regard to swine-plague Schizophytes outside the body of a hog, an occasional change of their nutrient vehicle (pabulum), effected by a temporary rising in the air of the new germs, and may be the micrococci, not only essentially promotes further development and propagation, but is also indispensable. Such a temporary rising in the air and coming down again with rain and dew, especially with the latter, which in many cases constitutes the only means of locomotion, was almost entirely prevented by the meteorological conditions just mentioned. The continued severe frost and the covering of the ground with deep snow effectually prevented an evaporation of water and consequently a rising of the Schizophyte germs; and the pouring rains and freshets which followed carried off most of the existing Schizophytes before any rising into the air could take place. Hence, during the latter part of last spring, most of the country, at least as far as this State (Illinois) is concerned, had become disinfected, and if it had not been for certain places which provided favorable conditions and afforded protection for the swine-plague Schizophytes, we might have got rid of the disease. But as it was, many hog lots and pastures contained old straw-stacks, &c., and much of the timber land near creeks and the headwaters of the rivers was full of underbrush and old vegetation, which afforded admirable protection against those meteorological influences so adverse to the propagation of the swine-plague germs, and, as a great deal of just such timbered land is used as hog pastures or hog ranges, a great many disease germs were preserved and survived, though in most places in a somewhat weakened or dormant condition. Only in some places—I shall have occasion to describe a few of them—the Schizophytes were preserved, it seems, in full vigor, and in them, and in them only, malignant cases of swine plague could be found, while at all other places where the disease made its appearance the prevailing type was a rather mild one.

After the pouring rains in the spring ceased, almost continuous dry weather set in. It was interrupted only by a few light rains and caused the whole season to be exceedingly droughty, until about the latter part of September, when it again commenced to rain. The swine-plague Schizophytes, therefore, which survived the effect of frost and snow in the winter, and were not carried off by the pouring rains and freshets in the spring, in many cases became deprived of an element very essential to their metamorphosis, propagation, and existence—they lacked a sufficiency of moisture. So again it happened that those still existing outside of the organism of a diseased hog survived only in such places as were not easily deprived of moisture by the continued drought; for instance, in old straw-stacks, and in timber containing much underbrush and old, rank vegetation.

Wherever those germs were under the protection of old straw-stacks and timber land containing much underbrush and old, rank vegetation, there they found an opportunity to survive and return to their work as they perfected themselves.

At any rate [the doctor says], timber-lots, pastures, and hog-yards containing old straw-stacks constituted the very places in which new outbreaks of swine plague occurred. It is the season of frequent light rains, of heavy dews, and of warm weather that is favorable to a rapid development and propagation of the Schizophytes. If we shall again have a hard winter—continuous frost and lasting snow—I am not afraid to predict that next year will bring very little swine plague, and that of a mild type.

Causes consisting in human interference.—One cause of the greater leniency and the slower spreading of the plague can be found in the fact that farmers, as a rule, have reduced the size of their herds of swine. Of course, the disease does not originate any more in a large herd than in a small one, but having once made its appearance and gained a foothold it will, for obvious reasons, spread much more rapidly, or attack more animals at the same time, and, as a necessary consequence, be more malignant in a large herd than in a small one. That such is the case was fully explained in my last report. A second cause may be found in better hygiene. On the whole, the keeping of swine has improved in the last few years; they receive better care, and it seems to me are kept, on an average, in cleaner quarters. The farmers have learned something; a great many of them have profited by the advice given in the reports of the Department of Agriculture; at any rate, some of the rules laid down in the reports in regard to the treatment of swine and prevention of the plague have found practical application in many places and in numerous herds.

Although there is no proof whatever [somebody has said that this was a natural infection] that swine plague can originate from uncleanliness, dirt, bad food, or poor care, there can be no doubt that bad hygienic conditions contribute materially in making existing cases of the disease more malignant, and not only in that way, but also (more directly) promote the spreading of the disease, because filth and dirt, stagnant pools of water, accumulation of half-rotten manure and of old straw in a hog-yard provide very favorable conditions for the preservation of swine-plague Schizo-

phytes, and also constitute exeellent vehicles by means of which a "natural infection" is easily effeeted. Besides all this, an animal compelled to live under bad hygienic eonditions possesses, on aceount of its weakened eonstitution, more predisposition and will sooner succumb to any zymotie disease than an animal properly treated and cared for. It seems to be one of the laws of nature that wherever a high organism is weakening or approaching decay, the lowest forms of life are sure to flourish.

Everybody knows that perfectly well. We say our animals are thin because they are covered with vermin. The fact is, the vermin attack them because they are thin. The man who feeds his cattle well, and protects them in good, clean, properly arranged stables, will have the least trouble. Therefore, what the doctor states is especially true. When the animal gets feeble and thin he is more exposed to the effects of these destructive germs of noxious diseases and to the vermin that are visible to the naked eye. Now I may be mistaken, but I have an impression that swine plague is not found indigenous to any great extent on those farms where swine are properly penned and systematically fed—where they are not allowed to roam at large, and where they are not fed in great numbers on straw stacks and refuse of the cattle. I have seen everything in fancy hog-pens, but I have never observed swine plague there unless brought from the outside. I think, when we remember this, we can attach more value to what Dr. Detmers says. If it be true that the disease originates in the region where there are vast masses of decaying straw-stacks, in yards covered with decaying corn-fodder, and where hogs are living, as they do very considerably, upon the refuse of cattle fed upon corn, then Dr. Detmers' statements are entirely worthy of consideration.

He speaks about the remedy in use, and tells what the germ or spore is. Giving an account of one experience, he says:

On July 8 I learned of the existence of cases of swine plague in the neighborhood of Ætna, a village in Coles County, on the S. C. R. R., about 52 miles south of Champaign. I went there at once and found a nest of disease in a little village called Paradise, 2½ or 3 miles northwest of Ætna, and near the upper portion of the Little Wabash. One and a half miles above Paradise, also on the Little Wabash, is a sawmill, at which quite a herd of hogs is kept, and at that mill, I was informed, swine plague was very bad six weeks before it broke out at Paradise. The owner of the mill, Mr. Hiram Clapp, was reported to have lost a large number of swine, and to have but a few diseased animals left. His herd had access to the Little Wabash. At Paradise I went first to Mr. R. Deckhard's place, and found one portion of his herd of swine, composed of four brood-sows, with their litters, and several shoats, in all about 50 head, in the orchard and barnyard; and another portion of the herd, consisting of a dozen shoats running at large, principally in the timber on the banks of the Little Wabash, which, at Paradise, is not much of a river, but only a good-sized creek. The whole herd had been running at large till recently, when the brood-sows and several of the smaller shoats had been driven into the orchard and barnyard. I found three dead shoats in and near the creek, three more dangerously sick, or in an advanced stage of swine plague and barely able to walk, and several others evidently ailing, while undoubtedly every one of the shoats running at large in the woods and not yet apparently diseased were more or less infected. I learned from Mr. Deckhard that his pigs had caught the disease from animals owned by his mother, who lives a little farther north and above him; or, at any rate, his mother's pigs, which used to be a good deal together with his own, had first commenced dying. Acting upon my advice, Mr. Deckhard drove all the outside pigs which did not appear to be ailing out of the woods into the orchard and barnyard, together with the brood-sows and pigs and some shoats, and left the very sick animals to their fate in the timber for the want of some better place to take them. They were not admitted with the others into the orchard and barnyard for fear of still more infection, and to subject them to treatment was considered useless. The herd thus shut up in the orchard and barnyard contained one very sick animal, a small, emaciated shoat with a temperature of 106° F., and half a dozen others evidently affeeted. I advised the removal of the very sick shoat, but Mr. Deckhard thought it might recover. The whole herd in the orchard and barnyard, which could not get any water except what was given to them in troughs pumped from a well, was subjected to treatment, and received three times a day ten drops of carbolic acid for every 100 pounds of live weight, in the water for drinking. This treatment was continued till July 26.

From Mr. R. Deckhard's I went to Dr. Deckhard's place, where I found three shoats shut up in an isolated, small yard. They had come from the herd of Mrs. Deckhard, the doctor's grandmother, had recently been transferred, and exhibited plain symptoms of the first stages of swine plague. All three were coughing, but had yet some appetite, and were active. I subjected them to the same treatment as Mr. Deckhard's herd. Mrs. Deckhard's place was not visited, because her son informed me that most of her pigs had died and that the few yet alive were convalescent. Another man in Paradise had lost three pigs (shoats), had two very sick, and one apparently healthy. Found also a case on my return in Ætna, but only in a small herd, originally consisting of six animals. Of these two had died, one was dying, and three were apparently yet healthy. Made the same provisions for the latter as for the infected animals in Paradise.

Went again to Paradise on July 12 and found all the animals in treatment doing well except that one very sick shoat with a temperature of 106° F. The sick shoats left to their fate in the woods were dead. The doctor's pigs were still coughing, but were no worse in any respect and had good appetites. Made another visit on July 18, and found every animal in treatment alive and doing well except the very sick shoat, which had died. The doctor's pigs showed considerable improvement. My last visit was made on July 25, when I found every animal in treatment, old and young, not only very much improved, but also thrifty and without any symptoms of disease. Those of Dr. Deckhard had stopped coughing and had gained in flesh. Not intending to come again, I requested both Mr. Deckhard and his son, the doctor, to send me word if anything should happen or if any relapse should take place. On August 18 I received word from Dr. Deckhard that all the pigs were healthy and doing well.

He records another experiment, also indicating his mode of treatment, but you can see from the extract read that these matters are within the reach of any common farmer. And when you remember the millions of dollars that are lost through swine plague, it does seem as if any man who had an ordinary desire for economy would resort to these measures at once, if his swine were exposed to the disease.

Speaking about the means of prevention, he says:

Wherever swine plague happens to be prevailing in a neighborhood no hog or pig must be allowed to run at large, but every herd and every hog should be kept shut up if possible in pens or yards on the premises of the owner. Considering the fact that the swine plague germs are discharged in immense numbers by the diseased animals with their excrements, &c., and rise into the air as Schizophyte germs, and probably as micrococci, to a limited height, on coming down are deposited with the dew or rain upon the grass, herbage, and into water, it is dangerous in an infected neighborhood to allow healthy swine to be in the pasture while the grass is wet with dew or rain, unless the rain has continued long and been sufficiently heavy to wash away everything that is very minute and light. Hence, when it is desired that a herd of hogs should have the run of a pasture while the disease is in the neighborhood, the time must be limited to between 10 o'clock in the morning and sundown, or to hours during which the grass is dry. The Schizophytes are soon destroyed where sunshine and fresh air have full access, and where at the same time moisture is wanting.

That is surely a very simple suggestion, and one which could be thoroughly tested all through those regions where the business of raising and feeding hogs is carried on.

Professor KNAPP. Will the Commissioner allow me to say a word?

The PRESIDENT. Certainly.

Professor KNAPP. I wish to suggest that these things have been circulated for years. He [Dr. Detmers] simply picked them up from the practical men in this country. I know it, because I talked half a day with Dr. Detmers before he was willing to accept those conclusions.

The PRESIDENT. Then you do not think he is wrong?

Professor KNAPP. No.

The PRESIDENT. It is all the better, if he has had sense enough to talk with the hog breeders and put the result in scientific phrase. I am very glad to know he was sharp enough to do that.

Professor KNAPP. The only point is, that it has been circulated time and time again.

The PRESIDENT. Exactly so. His course in this is an illustration of

what I said the other day, when endeavoring to define the application of science to agriculture: that there was a science of discovery, and that every man who had his wits about him as a scientist, would avail himself of all facts that came from any experience worthy of consideration. No doubt Dr. Detmers has discovered these facts from practical feeders and breeders, and being inclined to be guided by them, has put them together so that everybody will understand.

Professor KNAPP. Lest I may have cast a little reflection on Dr. Detmers, permit me to say that I did not intend to refer to this matter to his detriment in any way.

The PRESIDENT. I appreciate the point. Dr. Detmers goes out among the people and learns the facts of the case. Now he says:

> As to a medical treatment of an animal in an advanced stage of swine plague I have no suggestions to offer, as I have long ago come to the conclusion the sooner such an animal dies, or is put out of the way, the better it is for the owner, at least as far as dollars and cents are concerned. I advise those who yet believe in the possibility of curing (restoring to health) a hog in an advanced stage of the plague to make a few *post-mortem* examinations, to examine particularly the lungs, the lymphatic glands, the heart and intestines, and then compare what they found with the condition of those parts or organs in a healthy animal, and they will soon be converted.

Mr. FOREMAN, of the Indian Territory. Just a word, please, upon that subject. I heartily concur with the doctor in every point. I raise no question at all, but narrate an experiment—a practical, simple experiment. I make no pretense of being able to dissect and perform an autopsy, but as a man who has handled that disease, I may venture to make a statement.

In this last season, a car-load of hogs was sent to my mill from the country. So soon as I could get the hogs in the yard, I found that I had been sold instead of the hogs. They commenced to die very rapidly. When half of the eighty head were dead, I concluded an experiment might kill the balance and relieve me of the vexation. I went to the drug store and purchased a half pound of copperas, and used that quantity to each barrel of slop. As a result, I lost but one more hog, and now I ask, gentlemen, was it the copperas that saved those hogs or not? This is an actual experience.

The PRESIDENT (after a pause). The opening question this morning is sheep husbandry. That comes next in order. The paper prepared by Professor Webb will now be read, and I have no doubt that this and what other papers there may be, will occupy all the hours of the morning. Then there is a paper here which can be read, prepared by Mr. Cockrill, of Nashville, upon the stock interests of Tennessee, another on cattle interests, by Mr. Grinnell, and another short paper on the Guenon marks. The first proceeding in the afternoon will be the reading of a paper on forestry, which ought to be introduced now in order to serve the convenience of the gentleman who is to read it. That paper is from the pen of Mr. Baker, of Kansas, who was employed by me to examine the supply of timber in timber sections west of the Mississippi River.

Colonel BEVERLY, of Virginia. I understand the paper on sheep husbandry will be taken up first.

The PRESIDENT. Yes. That had better be thoroughly considered, and anything else in that connection. I shall be absent until two o'clock, and then if it be desired that any of these papers shall be read, I will read them. Professor Knapp will please take the chair while I am gone.

Professor Knapp thereupon took the chair.

Mr. WEBB, of Delaware. Mr. Chairman and gentlemen, it was with

reluctance that I consented to appear before this Convention with any paper upon sheep husbandry, or indeed any other subject; but it was desired by the people of the State of Delaware, from which I came, that our State should be represented here. I have therefore prepared a very short article, giving some of the practical points of sheep husbandry in Delaware, so that I have called my subject "Sheep Husbandry in Delaware." It is not intended to apply to other sections of the country. At least, I know it does not apply to many sections.

SHEEP HUSBANDRY IN DELAWARE.

By Prof. WESLEY WEBB, *of Delaware College.*

We start on the broad principle that stock husbandry is the foundation of successful agriculture. The truth of this proposition is capable of demonstration. It is especially true of the older parts of our country, and more particularly where the fertility of the soil has been carried away in every conceivable form of commercial products. The apparent exception, in cases where crops have been profitably raised on chemical manure, is only a partial one, for a large proportion of chemical manures is derived from animal products.

Few soils are so fertile that they can produce large crops for a long time without the application of manures, and in nearly all cases the cheapest way to supply these manures is to feed upon the farm the crops produced there. This is so emphatically true that often the products of the farm in a raw state are worth much less than when manufactured into beef, mutton, pork, or butter, cheese and wool.

Of all kinds of stock husbandry, the raising of sheep, lambs and wool has been found most profitable in many places. Such I believe to be the case in Delaware. Local exceptions, near milk markets, for example, will undoubtedly be found.

In 1878, Delaware had 35,000 sheep, which yielded 3.9 pounds of wool per head, or 136,500 pounds. This wool sold for 28 cents per pound, amounting to $38,120. These 35,000 sheep raised 26,250 lambs, worth probably $3.50 each, or $91,875. Thus the annual income was in round numbers $130,000, and it is probably about the same now. Here, as everywhere else, we find a wide range of practice in management, and a broad difference in the income of different flocks. If all flocks were bred up to a good standard and properly fed, they might be made to yield a very much larger revenue. It is not overstating the facts to say that 35,000 sheep might yield 210,000 pounds of wool, or 6 pounds per head, and raise 31,500 lambs worth $6 per head, making an annual income of $247,800, an increase of $117,800, or 90 per cent.

We will now consider how this may be done. Situated as we are in a climate where we feel neither the rigors of northern winters nor the excessive heats of southern summers, with a fertile soil, rolling and well-drained surface, good water and salubrious atmosphere, we can keep successfully the best and most productive breeds of sheep, and being near large cities and in the midst of woolen mills, we possess exceptional facilities for marketing the products of our flocks. With all these favoring circumstances, we have no need to keep a small, unproductive, unthrifty variety of sheep. Our low fertile lands are capable of carrying the largest and best breeds, such as the Leicesters and Cotswolds. But on much of the land of this State such large, long-wooled sheep will need some extra feed. So that for the majority of our farms, we need the Oxford, Shropshire, or Hampshire Downs. Either of these breeds will thrive with us, and in average yield, come quite up to the amounts I have named. But we have not reached our limit. We are not keeping all the sheep we might, in the present condition of our farms.

More than this, much of our land is capable of improvement. The sheep leave their excrement so scattered over the surface, and have a taste for so many kinds of plants, that they convert all the feed that grows in a pasture into the best kind of manure, and drop it where it will do the most good; so that our sheep pastures will, on good land, be constantly improving. But we need not wait for this. We can apply at once purchased manures, or overstock the pasture and feed an extra amount of food sufficient to keep the flock up to the standard. We may thus at once greatly augment the size of our flocks, and instead of keeping 35,000 sheep as at present, we may judiciously keep 100,000. And instead of realizing a revenue of $130,000, we may realize more than $700,000 per annum.

Shall we keep thoroughbreds or grades? If we have access to full-blood males and prefer to do so, we can buy each autumn a flock of ordinary ewes, breed them to a full-blood South-Down male, and raise early lambs, which will sell well in July. The sheep can be fattened to sell in autumn; and with wool, lambs and fat sheep we can secure a large profit. But that will make it necessary for us to change our flock every year, and to draw yearly from some source a fresh supply. I am not advocating such

a plan. My idea is to breed toward a certain high standard, which we can reach only by keeping some well-defined variety and retaining the best for breeders. To do this successfully, we must have co-operation among farmers. We should decide upon some breed as the one best adapted to our condition, and all work together to make the rearing of that kind a success.

The American markets do not demand exceedingly fat mutton. No better illustration of this can be found than the fact that a butcher refused to buy a flock of lambs in Delaware at fair prices because they were too fat! They were Cotswold grades, and had eaten no grain. What, then, is our course? It is a question which demands serious consideration, whether we cannot find a market for the fattest mutton. Such markets undoubtedly exist, but, unfortunately for us, they are on the other side of the great water. Mutton that is too fat for the markets of Philadelphia and New York brings a very high price in London. I believe we cannot do better than to fatten our sheep for that market and send them thither. One man cannot do this alone, but it may be accomplished by a combination of farmers. We need co-operation more in marketing our mutton than in raising it. In order to have suitable mutton for London we must have the best mutton breeds, and exercise care, judgment and discretion in all the processes of bringing them to maturity. The time has arrived for the exercise of all our talents and energies in this one branch of industry; and the person who shall carry to successful issue the plans which have been barely suggested here, mainly in securing the co-operation of all the farmers of the State in this vast enterprise, will have accomplished a work worthy of his noblest efforts.

The CHAIR. The next paper in order is one by Dr. Ellzey, of Virginia, on the same subject.

Dr. ELLZEY. Mr. Chairman and gentlemen of the Convention, delegated by the Virginia State Agricultural Society to represent them in this body, I am requested to read a paper on sheep husbandry, and I have endeavored to comp'y.

SHEEP HUSBANDRY SOUTH.

By M. G. ELLZEY, M. D., *of Virginia.*

Equally at home, whether nibbling in the shade of cactus and aguave on the sun-scorched pampas of the tropics; cropping the coarse plants of the salt marshes which border the bays and inlets of the coast; struggling for existence in depasturing of their scant herbage the wide old fields of pine barren and midland regions; luxuriating on the rich and luscious poa of the green meadow strips about the springheads of piedmont slope and mountain glen; or higher still, even above the summer clouds the fleecy whiteness of which he emulates, grazing peacefully where the broad lightning innocently plays beneath the shining feet of everlasting snows; everywhere at home, from shore to shore of this vast continent, and throughout the entire world in every region and in every spot accessible to human civilization, the sheep is a genuine cosmopolite and companion of man, furnishing him with bedding and clothing and food in vast supply and of the highest value.

Yet was it a renowned son of Virginia, of old Virginia as she was, not as she is, who is reputed to have said in a speech in the House of Representatives that he so despised a sheep, he would at any time go out of his way to kick one. This silly language was a mere vagary of a pure and lofty genius whose sufferings often betrayed him into extravagant speech. It will be well if those who represent what is left of old Virginia in the present Federal Congress shall utter only words of wisdom.

I have no personal familiarity with the rural economies of the Northern States, but I have had personal knowledge, observation and experience of the soils, climates, and agricultural methods in vogue from Maryland southward to Texas, and I have had a life-long familiarity with sheep. I know, however, that in Canada sheep are found very profitable, and even among the frozen hills of bleak New England flocks of the highest excellence have long been kept, from which sheep breeders throughout the country annually obtain animals for the improvement of their flocks at long prices. Good farmers at the North tell me that they find sheep husbandry profitable to them; at the South it ought to be doubly so.

I do not intend to ask this audience to listen to statistical details, or go into questions of arithmetic. The faithful statistician of this Department has all that worked out for those who want it, and the figures may even be had, indifferently accurate, at the Census Office.

I shall not be contradicted if I say that the winters are longer and colder from Pennsylvania northward than they are from Maryland southward, whereas lands are more costly and naturally less productive North than South. Wages are higher at the North, and the cost of the maintenance of the laborer much greater. In this

view, it seems that it must cost double as much to keep a flock of sheep north as it does south of the old line of Mason and Dixon. As to the cost per head of a flock of sheep well and properly maintained at the South, speaking generally, it is certainly, upon the strictest calculation, less rather than more than $1 per head per annum.

Gentlemen from the North can say if it is less rather than more than twice as much with them. A gentleman from Virginia, to whom I sold a South-Down ram, told me that he had thirty common ewes which he had bought at $3.50 per head, the price of the ram being $20. The flock cost him $125. The sheep were grazed on lands where theretofore only a few calves had ranged. They were fed no grain at all at any time, and only fodder when, for a few days at a time, the ground was covered with snow. They had no shelter es ecially provided, but gullies and clumps of cedars and pines afforded what protection they needed. No special attention was given them at lambing time; $5 would have paid for all labor bestowed upon them. The thirty ewes raised 39 lambs, for which $5 per head was paid him in the pasture at home. Not a single sheep was lost, and the fleeces averaged $1.20 net. I have known my father to make flocks of fifty head average $5 per head net profit year after year. I have found the breeding of pure South-Downs very profitable, though I paid very high prices for my foundation stock.

I could greatly multiply instances of good profits from keeping pure-bred flocks or grading up from common native ewes. It must be unnecessary to argue the question of the profits of sheep husbandry. It is scarcely to be thought that a well-informed, intelligent man will dispute the point.

I desire to urge attention, however, to the fact that there are millions of acres of land from Maryland southward now yielding nothing, dead, tax-bearing capital, which might be profitably occupied by sheep. The case given above is only a sample which may be duplicated on nearly every farm from the other end of the Long Bridge to the Rio Grande.

Moreover, there are millions of acres of semi-wild lands that, at a small annual cost, could be in a very few years profitably reduced to a condition fit for the occupancy of sheep, and which cannot, except at a ruinous outlay, be at present subdued to the plow.

But more than all else, I would warn the planters of the South that they cannot long continue profitably to produce their great world staple, unless they devise means of getting the seed fed out on the lands which produce the cotton. If seven-twelfths of that material, weighted down with the very fatness of the land, continue to go abroad, there will come not long hence a time of unavailing regret. Great fleets are riding at anchor in Charleston Harbor to bear away to foreign grain fields the precious phosphates, by means of which the wheat is to be grown, and from which the next generation must obtain their bread. Such reckless waste and destruction of natural resources, such criminal spoliation of the national domain, the natural inheritance of posterity, if committed in blindness, that blindness is in itself a crime. One of the chief points of interest about sheep-husbandry at the South is, that it will afford the means of feeding out the cotton seed crop on the lands that produce the staples, thereby stopping the great leaks that drain away the natural fertility of our soils.

Turn now for a single moment and contemplate what is being done to the grass and grain fields that produce the food supply of our urban population. The whole excreta of those populations, rich with the nitrogen and ash minerals of agricultural crops, are washed daily by the nefarious water-closet system into the sea or linger beneath our dwellings to befoul the fœtid soil and render deadly the air we breathe.

To what purpose is this extravagant and reckless waste by this generation of that which belongs to posterity, viz, the natural fertility of our soils?

I do not imagine that I am telling any new thing. The facts I state are known to every intelligent man, but men will not heed them without clamor, iteration and reiteration.

It is because sheep husbandry affords a large means capable of rapid and indefinite expansion of converting our crops into condensed animal products for market and manure for our fields that I so earnestly advocate its extension to the uttermost limit. There are men who clamor for the protection of industry by legislation and by prohibitory tariff, but who will vote against a dog tax, intended to foster one of the greatest, nay, the very greatest of our industries? It is true that we farmers keep, and permit to be kept by hired people and tenants about our premises, the dogs that kill our sheep, and then complain loudly that the legislature won't tax these curs which we ourselves keep and permit to be kept. There is sometimes a large degree of puerility and want of sense in the talk we make about this *bête noir* of the sheep husband—the prowling cur. The remedy is in our own hands. We complain of the neglect of our interests by the professional politician and the political "boss." Nevertheless we permit both the prowling cur and political "boss," seeing that we ourselves have a majority of all the votes. In Loudon County, Virginia, where I was born and

raised and still have my home, they have a dog law and they levy and collect a dog tax, and af er paying for all sheep destroyed they turn over the surplus to the school fund. That is a good law, and why not extend it to the whole State? Then there are buckshot and strychnine; let us kill all the dogs which invade our premises.

Another good idea is to tax all open sluts $5 a year; the tax on dogs and spayed sluts being $1. The collie dog is also a good protection to the flock against the ever-dreaded prowling cur. A picket fence five feet high is practically dog proof. So is a fence having a barbed wire at the bottom and one at the top, with boards in the middle not above five inches apart. Portable dog-proof sheep-folds may be made in a great variety of ways for the protection of valuable flocks by night, and collies may be used to put up the sheep and to protect them from rogues, quadruped and biped.

South of Mason and Dixon's line, sheep do better out of doors than when housed, and expensive barns and sheds are not necessary for them. Pine brush along the outside of fences which inclose fields and lots on the sides exposed towards the north, feed-racks in the shape of a cross, and other simple devices, afford what protection sheep need from the weather. South of the 35th parallel they do not need protection from the weather at all. But they do need to be fed hay, fodder or grain when the ground is covered with snow, which is never for many days at a time.

Upon the question of what breeds are best adapted to the great sheep-walks of the South I shall offer those opinions which reason and experience have formed for me. For depasturing the scant herbage of thin and rugged pastures, none of the pure breeds are best; nor can they be had at such prices or in such numbers as are necessary to stock our old fields, or even to occupy all our best farms devoted to mixed husbandry. It will be far better to begin by stocking up with the common native ewes and by using pure-bred rams, and gradually substituting the grade ewe lambs for the original stock of ewes, the latter being culled over every year and the least satisfactory sent to the butcher along with the wethers and lambs, and being replaced by an equal number of select grade ewe lambs. In a few years the whole flock will consist of grade ewes and some of them having two crosses of the thoroughbred breed. Continuing the process, the flock will soon come to consist of from three to five cross-grade ewes and thoroughbred rams. For all practical purposes these will be equal to thoroughbreds, and they will be fully adjusted to their environment. In this way the flock will appreciate in value at the rate of about 30 per cent. per annum for several years, while the annual sales will equal 100 per cent. of the original outlay.

The question I propose to discuss, therefore, is as to the best breeds from which to select thoroughbred rams for grading.

I shall make the matter short by saying that in all cases where the mutton product is the first consideration and wool secondary, I would select the South-Down; and in all cases where wool is the first consideration and mutton secondary, I would select the American Merino.

It will be in vain to hope that any very large breed of animals can be made to do well on poor land and under conditions of exposure and hardship. Two South-Downs will fatten on pasture upon which one Leicester or Cotswold or Lincoln will starve. In very hot climates it is well-nigh impossible to get the large and heavy breeds of domestic animals acclimated. If they do not die outright they go all to pieces in the most remarkable manner. In the true cotton belt, nothing is to be expected from the Short-horn or the Cotswold. Much more may be done with the Devon and the South-Down or the Merino. Percheron, Normans, and Clydesdales are "no good" in that climate; mules and mustangs do better there. For the purposes under consideration, light breeds of sheep are best adapted. For quality of mutton no breed rivals the South-Down. It is an old, uncrossed breed, very prepotent in crosses with other kinds. For fineness of fleece no sheep rivals the Merino; it, too, is an old breed and a very strongly defined type, and in consequence is also prepotent in crosses. By these facts I defend my selection of pure breeds from which to obtain rams to grade up the flocks to occupy the place in Southern agriculture which this discussion has in view.

But somebody will say, "You are a breeder of South-Downs and your opinions are biased and your judgment warped." Yes, I am a breeder of South-Downs, but my opinions are not biased nor my judgment warped by that fact. I breed South-Downs because I believe them to be certainly the best sort. I do not believe them to be the best sort because I breed them. I breed Short-horns too, but I do not think them fit for the pine barrens of North Carolina, nor the everglades of Florida, nor the canebrakes of Mississippi. I would not take them there myself; I would not advise anybody else to take them there for the sake of making a sale. I have been consulted about this very matter a great number of times and I have always advised persons not to buy Short-horns, but Devons, or Jerseys or Brahmin grades.

But it has been said to me, if the cotton seed is to be fed to sheep on the cotton plantations, so rich a food ought to be fed to large animals, say Cotswolds or some of the heavier down breeds. I think not. I believe that no breed of sheep consumes any sort of food so economically as the South-Down. Nevertheless, the matter may be

tried. If the South-Down has any rival, my belief is that it is the Shropshire. I think the Oxfords ought to be classed with the long wools. The Hampshires I do not like. They have large, coarse bones, big, ugly heads, flat fore ribs, and are much too long in the space across the flank from the last rib to the point of the hip. It is said by their advocates that they are the "coming sheep." That may be, but they have not "come." They can be mended much in form by more South-Down blood, and if I handled them I would unhesitatingly put it into them until they were properly barreled and ribbed home, and got some of the coarseness and ugliness out of them. They may be "coming," but in my opinion that is what they need to get them here. These are simply my opinions; they are to be taken for what they may be found to be worth.

In order to feed cotton seed to sheep with success, a cheap and wholesome food much less rich in nitrogen must be had to act as a diluent. The seed may be fed in troughs to sheep grazing on rye or turnips, or it may be mixed with ensilaged corn fodder. I incline to the opinion that the silo will here find its largest application.

The habit of growth of maize at the South is such that it produces far more leaves and stalk and less grain than it does north of the thirty-second or thirty-third parallels. South of the thirti-th parallel I have no faith in grass or clover, for sun and drought will be too much for them. Roots may succeed, but I believe ensilage will prove better. I have no doubt there are some ready to cast in my teeth that I am an eleventh-hour convert to the ensilage system. No, not so; I never said that the silo could revolutionize American agriculture. I never said that a man could get more food out of a silo than he put into it. I never said that an average crop of corn fodder on an acre of ground would yield 140 tons. I thought that 15 or 18 tons of green fodder, of which 80 per cent. is water, would be about the average, and that is what I think yet. Nevertheless, I have always said that I believed ensilage would find a permanently useful place in dairy farming. I now venture the opinion that it will find a yet wider field of usefulness in connection with the feeding out of the cotton seed on the lands that produce cotton, and that it opens the way to the successful introduction of sheep-feeding as a great factor in the industrial reconstruction of the new South. This is the problem which the practical agriculturist everywhere offers to science for solution. How may we farm profitably and not diminish but rather increase the natural fertility of the soil? I believe the answer will be found in a systematic rotation of crops, maintained by a system of green fallows, animal manure and commercial fertilizers, infinitely varied according to circumstances.

Mr. FOREMAN, of the Indian Territory. Sheep husbandry is a subject, Mr. President, in which I take great interest. Not saying it boastingly, I am recognized in the Territory as the head of the sheep husbandry by importing and thorough-breeding various kinds of sheep. I shall not attempt to speak before the Convention on anything but practical sheep husbandry—that is, its practical features—but before entering upon it permit me to state that I wholly concur with both of these papers. I say to the gentlemen who read the papers, that there is a sheep husbandry extending from the East to the West and from the North to the South. It covers our land. It is the industry that strikes at the very foundation of our best interests.

Taking that view of it, I speak for sheep husbandry in the West, from the great valley of the Mississippi, from the coarse grass of the Mississippi, which the gentlemen did not bring into comparison by stating the short grasses of their immediate localities. Taking that then for the ground, as the growth of the sheep herd varies over the whole face of the nation, the adaptation of it to the locality in which it is kept is one of the great questions before the Convention. The Merino is well adapted for the short grass, but for the gross grass growing saddle high, the Merino has no use. So I hold, not from my own experience alone, but from the best writings we can obtain in our land and in Europe, that the true sheep husbandry is in adapting the herd for the immediate locality by judicious cross-breeding.

I must, however, differ a little with the gentleman from Virginia upon special breeding. I concede to him, as far as he or a few individuals may be concerned, that he is nearly right; but upon the broad principle of sheep husbandry I must differ. Sheep husbandry, like

every other industry in our land, is in the hands of men who, almost nine out of ten, are very negligent. I am sorry to say it, but such is the proof. If they attempt to breed a certain class, they are not sufficiently careful to see that it is not inbred.

I venture my reputation that I can go into any man's herd you may select and point out the inbreds. I can tell them on sight in my own herd and anywhere else.

Allow me to refer to the Durham cattle. There is one great fault of the Durham cattle matter, and I wish to answer one point. I do not advocate the thorough Durham. Contradiction? No, gentlemen, I advocate a cross for our section of the country. Many portions of our range—we are speaking of sheep and cattle by the thousands, and not of your little 50-acre places—when we talk of our Durhams, we mean cattle by the thousands. There is a stream of water near which these thousands soon sweep the grass clean. Now the Durham thoroughbred, getting off a mile or two, is too lazy to go to that water, and hence the cross-breed goes beyond the Durham.

We must have more active animals. I hold then, that the profitable breeder of sheep will adapt his herd by cross-breeding to the locality in which he lives. I am thoroughly a Cotswold and South-Down man, so thorough that this last fall I sent to Canada and bought males for $50 apiece. I have 700 head of South-Downs now in the care of the herder. I speak from thorough, practical experience. Those cross-bred ewes carry with them the very elements I require for my locality.

I admit that we must go on the broad principle of a nation having a diversity of soil and climate. The idea arises in our Convention of estimating certain localities as governing the whole. Let us concede that one class of stock is good for one section and another for another; but my locality is not the place for the Merino. Now, cross-breeding, we find that from my herd, year before last, I got 37⅝ cents for the wool just taken from the fleece at my mill, when the quotation in the Saint Louis market was 38 cents—⅜ of a cent less than the Chicago market. If you will refer back to that time, you will find that your Merino wool was quoted 38 cents. I give that as the rank of the wool which my flock has produced. We have another object which does not seem to have been brought out here in the line I would like to have seen it. If we go back to the last five years, what do we find? We must not live in the days of our forefathers. Five years ago exporting beef and fat mutton to Europe was a matter we knew little about. I was in communication with the railroads, and with the stock-yards, with the butchers from Paris, France, who swept across our country to the Rio Grande, purchasing 2,700 head of fat sheep. One of these men stopped at my house for a day and I talked with him on the subject. He said he wanted a large mutton sheep, and here I must differ with the first paper about having sheep too large. You cannot get them too large, and in producing the cross between the South-Down and the Cotswold you obtain this admirable sheep adapted to a foreign market.

Now let me make a quotation of that matter. Take the Merchants' Exchange reports from Saint Louis, which issued daily last summer, and you will read the quotations of export beef at from 7 to 9 cents, while butcher beef was from 4 to 7 cents. To any of us who are raising for market, that is an idea, and therefore we conclude that export beef and export mutton should be large, strong and fat. Profit is what we are after. I do not wish to take up the time of the Convention and might continue further on that subject, but I have said this much so I may hear from those more able than myself.

Mr. WEBB. Mr. President, I believe the gentleman did not understand me exactly when he stated that I was advocating a small sheep and a poor sheep. The statement I made was, that our markets did not require so fat sheep as foreign markets, and that I believed it would be possible and profitable for us to fatten our sheep, in order to bring the highest prices in any market. My idea was to adopt that kind of sheep and bring it to such condition as would insure the best prices. That was a large and fat sheep.

Mr. GAINES. I will not detain the Convention long, but coming as I do from the South, and from that section of Virginia to which Doctor Ellzey in his very admirable paper alludes, I wish to express my earnest conviction of the truth of every word and every sentiment he has uttered upon this subject. The distinguished gentleman, from the Indian Territory I believe, has told us that we can have no one breed which will apply to all parts of the country, nor to any one system; but each particular district must have that system which is most adapted to it, looking to the one great idea of profit. Now, sir, in that I agree with him most heartily, and my object is not so much to indorse what Dr. Ellzey has said as to express my conviction of the importance of that paper and the hope that it will appear not only in the records of this Convention, but be immediately published and disseminated throughout the South. We are in a peculiar condition in all that district of the South which has in its past been devoted to the planting and production of staple products exported entirely out of the country, and which have found a market abroad. We are in the condition where we can only make mixed husbandry profitable, and mixed husbandry only is possible. We cannot indorse the system which is so profitable upon the great plains of the West, nor can we adopt the system which you call profitable in the Northwest or the North. We must now recuperate our land, and we require a system that will enable us to work our lands with some profit and at the same time recuperate them. The essays of the gentleman from Delaware and Dr. Ellzey I think point out the direction. I will allude to just one point made by Dr. Ellzey. I have tried various breeds of thoroughbred sheep, horses and other animals, but the thoroughbred South-Down is the only thoroughbred animal that will maintain itself cheaply and can be made profitable and held in flocks in my section. I can make more profitable breeding by crossing them upon the common ewes of the country. But I tested the Shropshire, thinking that a little larger carcass and a little more wool would be more profitable. I found after one season that I lost my flock and the produce of that breed. I have been losing annually. There is something in the climate and in the grass that does not suit them, and they are continually going off to die.

Mr. S. S. BRADFORD, of Virginia. Mr. President, we are drawing to the close of this Convention, and time is becoming precious. I do not propose to occupy but a very few moments, for I have come here to listen and not to speak—not to teach, but to learn. Candor compels me to say that during this Convention I have been not only agreeably entertained but edified by the papers read and the discussions following. It was my misfortune not to have been here a little earlier to have heard the full paper of my learned friend, Dr. Ellzey. I regret it exceedingly, and look forward with much interest to the time when I shall be enabled to read it in print. I hear so indifferently that I frequently misunderstand, probably, the assertions of gentlemen. I differ widely with Dr. Ellzey, if I understand him to have said that, south of the Potomac, shelters were not necessary for sheep. I believe the farther

south you go the more important the shelter for sheep. There is nothing so detrimental as rain water, except as the sheep imbibe it. Any flock of sheep would be greatly enhanced in value, be much more thrifty and yield more wool, if it never saw a drop of rain water. A dry climate is peculiarly adapted to sheep husbandry. Even in our mountain regions, which one would suppose, of all sections of the country, best adapted to sheep husbandry, they do not thrive so well (though the herbage is the best on earth for them), because of the dampness to which they are subjected and the dews in the morning and frequent showers during the summer, when it is dry in the lower regions. It would be a fatal mistake, I think, especially for the Southern people, to believe that they can grow sheep more economically by exposure to the weather during the whole year than they can by having comfortable sheds for them. Open shelters are of very little value, for the reason that, unless sheep are accustomed to them from their birth, they will not go into them in any degree of weather—rain or cold. The sheep is naturally a timid animal. It is suspicious of danger all the time, and it is a difficult matter to get sheep into thicket to protect themselves from the cold or storms of winter. Consequently, they will not frequent an open shelter in bad weather unless they have been educated to it from lambhood. It is therefore necessary to have closed shelters into which you can drive them. The advantage might not be commensurate for the trouble and inconvenience of driving them into sheds when a storm suddenly comes up in the summer; but the building of barns is one of the most economical investments that a farmer can make on his land. Even with a view to the housing of his hay in barns, the investment will pay 25 per cent. annually in economizing his hay—hay cut early in the summer, when perhaps it is hardly mature enough to be mowed; but those who have large crops find it necessary to commence a little sooner than they would like, because they are sure to find it much too dry at the close of the harvest, otherwise. They may put it into barns if they dread exposure to the sun, when perhaps it could not be put in stacks under thirty-six hours. When put into barns in a partially green state, nothing is lost from the leaves or blossoms. You take it out in the winter as you put it there. There has been no deterioration, no loss, and stock eat it as readily almost as they take the herbage from the pastures. Now, in addition to the protection the barn will afford, it can be made economical for this storage, and as a result you will have a saving in wool and a healthful, thrifty flock of sheep. It is to the interest of every farmer to erect barns of sufficient capacity to hold the hay he makes, and accommodate all his stock, unless so very largely engaged in the business as to make it impracticable.

I need scarcely say a thing in regard to the different breeds of sheep and their adaptation to several localities. It has been said that the surroundings of the farmer must determine the particular breed for him, but it must not be overlooked that in the same sections there is sometimes a great difference in the temperature, owing to the protection of ranges and hills on the northern side of the farms. But the different breeds of sheep, like other animals, have been wisely constituted by nature for different conditions and surroundings. There are thousands upon thousands of acres now idle and producing nothing, that cannot be made profitable in any other way. These lands may be made to pay something by sheep husbandry, and for that kind of sheep husbandry there are large tracts with but few grasses and little herbage of any kind, where numbers of sheep could find a living. There is no question in my mind, after thirty years' experience, that the only breed of sheep

that can be utilized there is the Merino; but wool must be your staple. The Merino is of slow growth and late maturity. It is of no value as a lamb, because you cannot bring your lambs up in time to the size that meets the demand. Before they are large enough to be eaten, the high price of lambs has fallen to a considerable degree, and lamb is then worth no more than mutton, whereas the merino from three to five years old, when fattened, makes a mutton inferior to none I have ever seen—not even excepting the South-Down. It is not the best economy to use Merinos if you have good pasturage and plenty abounds. Nor can I agree with Dr. Ellzey that the South-Down is the most profitable. It is a fine, healthful, thrifty sheep, something like the Merino, which has the greater longevity, and therefore the lambs will not be as large at a given age nor will their carcasses and frames be so heavy. There is much in favor of the mutton of the South-Down that makes it more salable, and any sheep that you send into the market, if it has a gray face and legs, will sell very readily at high price if it be tolerably fat. That is because gentlemen of means and epicures think it is the best mutton the world can produce. I was struck with the wisdom of my friend, Colonel Beverly, yesterday, when he spoke of Devon cattle as best adapted to that heavy pasturage. While I think the Merino is a very desirable animal in most parts of my section, I could not recommend it on rich fertile soils. My opinion will not be charged as having proceeded from interest, for although I have been breeding and crossing Merinos for thirty years, I am doing it in a very small way now, because I cannot afford it. Since wool has declined so much, and this decline has been, I think, by reason of improvements in machinery, fine wool is not likely to be ever again so much in advance of coarse wool, and therefore Merino sheep cannot be so profitable as other branches of husbandry.

It is very unwise for my friend, Colonel Beverly, with his broad acres of blue-grass so thickly sodded that the hoof of a bullock weighing a thousand pounds will make no more impression upon it than would the beautiful slippered foot of one of his lovely daughters upon his Brussels carpet, to devote such land to Merinos.

Mr. FOREMAN. As the record will go to the country, I would wish to be placed on the side of shelter for sheep, notwithstanding gentlemen upon the floor advocate no shelter for sheep, which I am willing to concede for their locality. I will give you an idea of the necessity in the central and western portions of the country. We are subject there to sudden changes—so sudden that you may walk in your shirt-sleeves and in an hour afterward will need your overcoat. In the night there may be no ice upon the stream, while the next morning you might pass a thousand cavalry over it. You may suffer your sheep to be exposed to that this year, and the next year you will go around complaining that your sheep have the rot.

If a human being were exposed to changes so sudden he would contract the consumption; therefore, give shelter to your sheep. As for those gentlemen fortunate enough to live in so genial a latitude or climate, I am perfectly willing they shall be placed on the record as desiring no shelter for sheep.

There are over one hundred thousand sheep that, for want of grass, crossed the Rocky Mountains from California to the Panhandle of Texas. Last year thousands and tens of thousands have gone on the road from Indiana, Ohio and Michigan. I went down to Texas to attend to a little business, and while there, desiring to see how the sheep were getting on, I visited the second tier of counties from Fort Worth.

I found the herds collected from Indiana, Ohio and Michigan, on the open plains. They were dying beyond all count, and next year will all be gone.

The CHAIR. I will call Mr. Gaines to preside. I am compelled to leave on account of a friend going to Baltimore. I am sorry to interrupt the gentleman in the midst of a very interesting discussion.

Mr. Gaines thereupon assumed the chair.

Mr. FOREMAN. My visit to Texas, only a week before I started to this Convention, satisfied me conclusively about this one fact. I am studying and studying, and have remained to listen to this discussion. It has been the very soul of my interest in this Convention. These herds had been raised with shelter-sheds, which you know is the custom in those States. They were brought from their natural, native grasses, and thrown on wild grass upon an open prairie, not a shrub in sight and nothing but the herdman's little tent and the corral to guard them. If we do not treat stock kindly, we shall have no beneficial results, and I say we should have sheds in our locality notwithstanding the warm climate. Now, as to sheep being backward in going to sheds, I have my barn-sheds, and they come to them as regularly as the chickens go to roost. But if sheds are not properly constructed and in such condition as will crowd them and are not properly ventilated, your sheep had better stay out. Give them plenty of ventilation. As a matter of humanity and economy I advocate sheds.

On motion, the Convention here took a recess until 3 o'clock p. m.

AFTERNOON SESSION.

The Convention was called to order at 3 p. m.

The PRESIDENT. Mr. Baker, of Kansas, will now read a paper upon certain forestry questions in which the country is interested.

Mr. BAKER, of Kansas. Mr. Chairman and gentlemen, I assume that all present are acquainted with the condition of the country as revealed by the figures of the Census Bureau in regard to the forestry depletion, and assuming this, I shall not read any figures to prove that condition. I do not appear here as a scientist nor in this connection as a specialist, but rather as a practical business man to say in a very few words what, in my opinion, ought to be done.

FORESTRY.

By F. P. BAKER, *of Kansas.*

NATURAL CONDITIONS.

The vast country assigned to the writer for investigation is bounded on the east by the Mississippi, on the west by the winding chain of the Rocky Mountains, and extends from the British possessions to the warm waters of the Gulf. It embraces the States of Minnesota, Iowa, Missouri, Arkansas, Louisiana, Nebraska, Kansas, Texas, and a portion of Colorado, and portions of the Territories of Dakota, Montana, Idaho, New Mexico, Arizona, and the Indian Territory. Of this region the States of Missouri, Arkansas, and Louisiana are largely covered with native forests, and Arkansas in particular stands in need of facilities for bringing her magnificent lumber to market, and the day, it is hoped, is not far distant when the cypress of Arkansas will be as well known as the pine of Michigan and Wisconsin. Outside of these three States—Missouri, Arkansas, and Louisiana, which will be set aside for the present, to be spoken of hereafter—there yet remains an empire to which the subject of forestry is at present a vital one. The Mississippi throughout its length is lined by forests which increase in width as the number and size of its tributaries increase in volume. It is the presence of this great river which may be said to make forest States of the three we have mentioned.

In Minnesota the belt of forest is comparatively narrow; in Iowa somewhat wider and it is in those States that the great prairie region begins which extends to the foot-hills of the Rocky Mountains. Going west from the Mississippi the Missouri is encountered, lined with forests for the last 200 miles in its course, above that running through a comparatively deforested region.

At the Missouri begins the ascent to the Rocky Mountains, the great field for the future exercise of all that man has learned or can acquire of the science of forestry. This region, as the elevation increases, becomes more bare, and, to the eye accustomed to mountains and forests, desolate. The forest keeps up a gallant struggle along the streams which flow eastward to the Mississippi and Missouri, the Platte, the Kaw, and the Arkansas, but finally diminishes to a thin, winding fringe of cottonwood or willows, and the eye for hundreds of miles sees no more till the pine-covered slopes of the Rocky Mountains appear dimly in the horizon. The traveler, coming within sight of the mountains and then turning southward, comes to New Mexico, with its mountains, ofttimes bare to their very summits, and at other times covered with piñon and pines; its wide plains watered by inconstant, treeless streams and occasional ponds or lakes, traversed by but one stream of magnitude—the red, turbid Rio Grande, its banks destitute of trees or verdure save where the patient Mexican has dug his acequia or irrigating ditch. Then to the westward lies Arizona, a country of mountains, bearing everywhere the traces of volcanic action, extinct craters, lava beds, and the veritable sandy desert. As the border of Mexico is approached the barrenness increases. Nothing relieves it save where man has overcome it by irrigation. The Mexican does not rely on trees for his wood, but digs for fuel the heavy, branching roots of the mesquite. If the traveler, when within sight of Pike's Peak, turns northward instead of southward, and keeps his course parallel with the mountains, his way will lead him over the high plains, better watered and less desolate than those of Mexico, but equally destitute of trees. Such is a general view of the country under discussion.

When the first settlement of this region began, the north half of Minnesota was covered with white pine, and south and west of the pine belt was a large body of hard wood, consisting of white, red, and burr oak and sugar maple. Of the total forest of the State (pine and hard wood mixed, and hard wood), it is safe to say that fully one-half has disappeared. Of the total area of hard wood, it is estimated that but 4,000,000 acres remain, the area of the State being, in round numbers, 54,000,000 acres.

The history of Iowa is that of the prairie States generally. The settlers found on the banks of the Mississippi, the Des Moines, its principal tributary, and other streams, a considerable amount of timber. This they proceeded to use up, after the manner of the American pioneer, particularly when he encounters timber on the Government lands. Nature has since been repairing damages, but native timber has long since ceased to be a matter of reliance. In 1875 the forest area of Iowa was estimated at 2,300,000 acres, the area of the State being 35,000,000 acres.

Nebraska, as opened for settlement, was almost entirely destitute of timber. The supply was confined to the belt along the shifting banks of the Missouri, largely composed of willows and cottonwoods, with a hard growth in the bluffs and the ravines which intersect them. At the mouth of the Platte was a heavy body of cottonwood, and along the banks of that stream, where it was entered by tributaries, were groves of white and burr oak in area from 100 to 500 acres. Within the original limits of the Omaha land district, containing 2,560,000 acres, and comprising the most heavily timbered district of the State, the original plats showed but 75,000 acres of timber.

Kansas, although counted among the "treeless" States, was, in the beginning, blessed with more forest than Nebraska. Pike, who explored the country in 1806, speaks of the region now comprising the east third of the State as a good country; but beyond the first 100 miles from the present border of the State of Missouri, he doubted if the country could be settled on account of the absence of wood. Within twenty years a fine body of forest extended along the Kansas River from its mouth to 135 miles west. In some localities, as at Topeka, 60 miles west of the mouth of the river, the body of timber, comprising fine specimens of every tree known to the latitude, was six miles wide. Colonel Fauntleroy, in urging in 1852 the establishment of the post since known as Fort Riley, at the point where the Republican and Smoky Hill unite to form the Kansas River, mentions the locality as desirable on account of the existence of one of the finest bodies of timber in the West. The banks of the Neosho, from Council Grove to the present line of the Indian Territory, were heavily timbered. Large bodies of cottonwood were found at Lake Sibley and other points on the Republican. The Marais des Cygnes, and in fact nearly all the streams of Eastern Kansas, were well timbered. Even in the extreme northwestern portion of the State, nearly to the borders of the plains of Colorado, fine groves existed on the small tributaries of the Republican, one of them being early named the Driftwood. After all the ravages of twenty years the amount of timber in the State is estimated at 2,560,000 acres, or 4.92 per cent. of the whole area.

Colorado had, at the time of the discovery of its mines, 25 years ago, a great body

of pine, spruce, fir, and other trees covering its mountain sides. In 1870 it was estimated one-third, possibly one-half, of the trees in the settled portions of the Territory had been destroyed by fire and ceaseless slashing. Since that period railroads have penetrated the country, and have added to the destruction by consuming millions of ties. The original forest lands of Colorado are now being converted into deserts.

Wyoming is a country of high plains and lofty mountains. In 1873 it was estimated that there were 2,000,000 of acres of timber in Northwestern Wyoming. The business of cutting off the timber for railroad ties has been going on for many years. The consumption has been estimated at 500,000 ties per annum. Charcoal burning and the demand for mining purposes have also diminished the native timber. The elevation of the country renders it liable to frost every month in the year except July, which enhances the difficulties surrounding artificial forestry.

The mountains of Montana were originally covered with forests of pine, spruce, fir, cedar, and balsam. These forests have been ravaged by fire, and it has been noticed that where timber is once destroyed on these mountains it is not followed by a second growth.

Idaho presents great contrasts of surface and vegetation. The finest body of red cedar on the continent exists in this Territory, and, on the other hand, there are 16,000,000 acres of sage brush lands, which are, however, for the most part, susceptible of irrigation, and so offer a field for tree cultivation.

Dakota is a prairie country, and resembling in its general characteristics the adjoining portions of Nebraska and Minnesota.

It will be seen that the region west of the Mississippi and east of the Rocky Mountains comprises a great variety of soil and climate, and really the region should be divided into great districts, each to be made the subject of investigation and report. In such a division one district might be properly made of Minnesota and Iowa; another of Eastern Dakota, Nebraska, and Kansas; another of Wyoming, Western Dakota, Montana, Idaho, and Colorado; another of New Mexico and Arizona; and yet another of Missouri, Arkansas, Louisiana, Texas, and the Indian Territory. In some sections timber grows naturally in abundant supply; in others the need is planting and cultivation; in others, in addition to planting and cultivation, irrigation seems a necessity. In other districts the question is that of preservation.

Every portion of our country is interesting in connection with the purposes and labors of the bureau of forestry, but the most interesting field of research and labor is that portion of the continent which is embraced within the limits of the States and Territories we have mentioned, and the boundaries of which were defined as follows by Mr. H. M. Thomson, of Lake Preston, Dak., in a paper read before the Forestry Congress at Montreal at the meeting in August, 1882:

"The Great Plains extend from the southern limit of the Staked Plains in Texas northerly about 20 degrees of latitude to the Saskatchewan River and Hudson's Bay, and from an irregular east line, commencing in Texas, running through the eastern part of the Indian Territory, Eastern Kansas, and Nebraska, Western Iowa, the big woods of Minnesota, and the Red River of the North; westwardly of this irregular eastern limit an average distance of about 10 degrees of longitude to the foot-hills of the Rocky Mountains, and containing an area of about 950,000 square miles. If all this region possessed a propitious climate, and all the soil were susceptible of cultivation, the area is sufficient to make 3,800,000 farms of 160 acres each, and which, by the aid of a proper forest economy, may be made capable of supporting an agricultural and pastoral population of fifty millions."

WHAT HAS BEEN DONE.

The first great step toward the promotion of forestry in this country was what may be called a change of sentiment in regard to the value of forest trees, a change which has taken place within the last half century. The pioneers on the continent made their settlements along a heavily-timbered coast, and for the better part of two centuries literally hewed their way toward the interior of the country until the great prairies were reached. Trees were not only cut down for use, but were slashed and burned and girdled. It seemed to be the purpose of the early American settler to destroy as far as possible the native forest. The woodman's ax was the symbol of civilization, and the State seal of Indiana bears the figure of a wood-chopper.

The setting out of orchards was, of course, the work of the earliest pioneers, a passion for fruit trees having been brought from England; but the idea that a forest tree was of any value except to be used up for rails or posts or boards, or burned to ashes for pearl-ash, is of comparatively modern origin. Even when the settler reached the prairies of Illinois, where timber compared with the older States was very scarce, he does not appear to have exercised the least care or foresight. If he lived near the bodies of forest which skirted the streams, he cut them down for rails or cord-wood, as if the supply was inexhaustible, and out in the prairie the settler contented himself with

hauling green wood a long distance for firing, nor dreamed of setting out groves about his house which should supply his demand for fuel at less trouble and expense.

Kindly nature strove to repair damages, and in many instances successfully. And when, in time, men heeded the warning and became less lavish in the work of destruction, the woodland began to gain in area, until in many parts of Illinois it is now much greater than when the country was first settled. In time came the discovery of coal, which lessened the consumption of wood for fuel; and the question of material for fencing becoming serious, hedges and other substitutes for posts, plank, and rails were resorted to. Thus by degrees the subject of the value of forest, and so the possibilities of forest culture, became impressed upon the people; in short, forestry became a subject of popular interest.

An augmentation of this interest came with the settlement of the country west of the Mississippi, and more especially west of the Missouri. Here were immense treeless areas, and believed by the first explorers to be uninhabitable on account of the absence of forest for building, fencing, or even fuel; it was known that travelers and hunters traversing these plains used buffalo chips for fuel. And yet here were millions of acres of surpassing fertility, opened to settlement by the passage of the homestead act; and the progress of settlement stimulated by the extension of the railroads. It will be seen that under these conditions the forest question became one of the first importance. The rivers and the railroads solved the problem of building by bringing pine from the forests of the North, and the demand for fuel was met in part by the opening of mines of bituminous coal, which seem providentially to exist in most prairie countries. The fence question was met in Nebraska and Kansas by the general adoption, after much discussion, of the herd law, which does away with large farm inclosures. In the settlement of these trans-Missouri States every step tended to reveal the transcendent value of forests. The lack of them, though supplied as we have said, was felt, and as soon as horticultural and agricultural societies were formed, tree-planting became a subject of eager, active, and constant discussion, and so has continued to be ever since. It is safe to say that there has scarcely been a number of an agricultural or horticultural paper issued in the States of Minnesota, Iowa, Nebraska, or Kansas, in which the subject of tree-planting has not been discussed.

The first efforts to repair the deficiencies of nature were those made by individuals. All through the country embraced in the limits of this report is found a tree of quick and early growth, requiring little in the way of sustenance, living a long time on water alone, planting itself in the most unexpected places and sowed by the busy winds. This tree is the cottonwood, and being the first at hand it was everywhere seized upon by the settler and planted by thousands about the homestead shanty, along the boundaries of the prairie claim, and in the little public squares and along the streets of the villages which spring up in a week or a month. Although time and trial have proved that the cottonwood will not sustain itself on the high prairie unless carefully cared for, dying like the Indian with the growth of civilization, it will yet be held in remembrance in this western country as the first of trees, and its planting as the beginning of forestry. Many a settler in years to come will recount how the armful of little cottonwoods, which he pulled with his hands on the sandy bank of the river and carried to his claim, furnished in time the first shelter from the fierce winds and the burning sun.

In time the pioneer tree was followed by others, the black walnut, the maples, the box elder, the catalpa, and with wonderful success. The denizen of the town in Minnesota, Iowa, Kansas, and Nebraska proved quite as enthusiastic a tree-planter as the farmer in the country, and in Kansas, the newer the town, as a rule, the more zeal has been displayed in the matter of tree-planting. Lawrence, the university city of Kansas, after twenty-five years is a town full of verdure; but the same is true of Wichita, a town which seven years ago stood treeless on the bare, sandy bank of the Arkansas.

As to the results of individual effort, without encouragement from the State or from societies, a small portion of the immense amount of evidence which might be furnished is herewith submitted.

The latest standard authority on tree culture in Kansas is the "Second report on Forestry, by the Kansas State Horticultural Society." In this pamphlet, in the shape of county reports, is briefly summarized the results of tree-planting in Kansas, together with the teachings of experience in regard to proper varieties, &c.

The counties reporting, through careful observers and practical tree-growers, are Allen, Atchison, Barbour, Barton, Butler, Chautauqua, Cherokee, Crawford, Cloud, Cowley, Davis, Dickinson, Edwards, Ellis, Elk, Harper, Harvey, Jackson, Jefferson, Jewell, Johnson, Kingman, Labette, Leavenworth, Lincoln, Lyon, Marshall, Miami, Mitchell, McPherson, Montgomery, Morris, Pratt, Ness, Nemaha, Neosho, Ottawa, Pawnee, Pottawatomie, Reno, Rice, Rush, Russell, Saline, Sedgwick, Sumner, Wallace, Washington, and Woodson. A glance at the map of Kansas will show that these counties represent every variety of soil and climate within the limits of the State, and from the earliest settled counties, on the banks of the Missouri, to the newest, far out

on the high plains, and from the Nebraska line to the Indian Territory. The highest of high prairie and the low level bottoms of the Arkansas, but a few feet above the level of the river, alike send the same report, "Timber culture seems to be made profitable in this country."

Taking the older counties, Leavenworth reports:

"Timber groves were planted in 1860, of cottonwood chiefly, and on upland, many of which are 50 feet high."

And taking the newer counties, Saline reports:

"The age of the oldest successfully grown timber lot or grove in the county is not over ten years old; was planted on low lands, and composed of cottonwood. The average diameter of these trees is 12 inches and the height 50 feet."

The correspondent from Sumner County reports:

"Timber-growing can be made a profitable investment. My first planting, now eight years old, affords me posts and poles for their uses on the farm and considerable fuel. I would not be without it for $50 an acre."

These extracts are from the report two years old; as to later evidence, Hon. Martin Allen, of Ellis County, an old resident of extreme Western Kansas, writes:

"I have myself been cutting and using timber for a number of years that has grown on the prairie since I came here, and many others within my knowledge are doing the same. Even the slow-growing black walnut has made annual additions of near an inch in the diameter of its trunk."

Hon. H. C. St. Clair writes from Belle Plain, Sumner County, Kansas:

"In this county there are thousands of acres of cultivated timber. Every good farmer, one that has now come to stay, has from one to ten, and some twenty, acres in timber, consisting of cottonwood, walnut, ash, elm, box elder, maple, ailantus, and catalpa. It is true that some varieties are of slow growth, and a beetle destroys the cottonwood on the high lands; but where timber lots are cultivated like an orchard, as they should be, timber-raising is a success, and money spent by the Government to encourage timber culture on the plains is well spent."

Theodore Boggs writes from McPherson County, in Western Kansas:

"There have been a great number of timber filings made in this county, and while some of them have been changed to homestead or pre-emption entries, there are a great many timber claims under a good state of cultivation, and the trees in most instances are healthy and doing well. I have trees on my farm near McPherson planted in the spring of 1873 that are as large at the butt as a man's thigh, and they are healthy and show no signs whatever of decay. The repeal of the timber-culture act would be a very bad thing for the plain regions, and I should be sorry to have it done. There are timber claims in this county that could not be had for $5,000, and inside of five years they cannot be had for $10,000. There is no question about the success of timber on these prairies if it is only planted and cared for."

So much may be gathered of the results of tree-planting in Kansas.

Nebraska in the matter of systematic forestry is far in advance of Kansas. Possessing a much smaller area of natural timber than Kansas, the efforts of the people to cultivate artificial forests have been more vigorous. The statement is made by J. T. Allen, forester of the Union Pacific Railroad, that Nebraska has now growing, and in the best possible condition, *forty-five million* of forest trees, and this planting extends 300 miles west of the Missouri River.

SUCCESS OF THE MENNONITES.

Under our homestead system, in fact under the general system by which the West has been settled, there have been exhibited few of the benefits of co-operation. Each settler is independent. He is supreme on his own quarter section, giving and receiving little help from others. Were this different, did the settlers of a given district join with each other in developing the country, did they combine, for instance, in the great work of rendering the land beautiful and profitable with trees, much could be done. How much is shown by the example of the Mennonites in Kansas! These people, bound together by a community of race and religion, and the fact that they were all alike "pilgrims and strangers" in this country, emigrated from Russia in large bodies in 1876 and 1877, and settled for the most part in the counties of Harvey, McPherson, Marion, Butler, and Reno. They bought land in severalty, yet in contiguous tracts, and have, without being allied in any socialistic bond, aided each other in their labors. Settling in an open prairie country, they have transformed it. Being intelligent tree-planters, they have surrounded their dwellings with fruit and forest trees, so that at a little distance a Mennonite settlement looks like a grove. They early introduced the culture of the Russian mulberry, which, under their system of careful cutting, furnishes in three years from the start abundant fuel, beside fruit, and the leaves for feeding the silk-worms. The same care and skill everywhere displayed would transform the great plains and change the climate of the western half of the United States.

ARBOR DAY.

An instance of the value of united action, even though for a brief period, is seen in the institution of "Arbor Day." The credit of designating a certain day in the year when men, women, and children shall join in planting trees is due first to the State of Nebraska. It was later taken up by the State Forestry Association of Minnesota, and on the first Arbor Day in that State, in 1876, 1,500,000 trees were planted. Premiums were offered by the State Forestry Association and by individuals until every farmer in Minnesota seems to be a forester. In Iowa Arbor Day has become a fixed institution. In Kansas the day was first observed by the citizens of Topeka, who turned out under a proclamation from the mayor and filled the capitol grounds with trees, which remain to this day. The governors of Kansas have since issued their proclamations for the observance of Arbor Day, which has been observed, however, principally by the school children, who have by their efforts greatly beautified many school grounds in the State.

ACTION OF RAILROAD COMPANIES.

We have spoken heretofore of the work of individuals. The work of forestry has been carried on to some extent by railroad companies, but not to the extent desirable. The Atchison, Topeka and Santa Fé Railroad Company in Kansas some years ago employed a forester, but afterwards, probably believing that the experience of private parties had fully demonstrated the fact that trees *would* grow to the extreme western limits of Kansas, abandoned the experiment. The following statement is instructive in this connection: Under date of October 18, 1882, Mr. C. H. Longstreth, late forester of the Atchison, Topeka and Santa Fé Railroad Company, speaking of the efforts of that corporation to grow trees on the great plains, after it had been a question of great doubt whether trees could be grown there at all, states that, in connection with S. T. Kelsey, in 1873, he commenced tree-planting at Hutchinson, Kans., working from there westward. He says:

"The object of our work was to settle this question and learn as far as possible what kinds of trees were best adapted to this part of the State for forest purposes. We did not do much until the spring of 1874, when we did considerable in the way of planting seeds and cuttings, most of which grew and promised well. In February, 1875, Mr. Kelsey left the work, after which I continued the planting and growing of trees until 1879, when, having the grounds all filled out and trees in such shape as to require but little care thereafter, the railroad company concluded best to discontinue the work and not plant any further.

"Since 1879 the trees have had no work expended on them whatever. Below I give notes of growth and number of trees now growing, which I took a few days since:

"First point, Hutchinson, is 180 miles west of the east line of the State; elevation, 1,500 feet; soil, light, sandy loam. Here are now growing—

	No. of trees.
Cottonwood, 30 to 50 feet high	1,000
Box-elder (ash-leaved maple), 15 to 20 feet high	8,000
Black walnut, 12 to 18 feet high	2,500
Green ash, 15 to 20 feet high	3,600
Ailanthus, 18 to 24 feet high	1,200
Catalpa, 16 to 20 feet high	2,000
Elm, 15 to 18 feet high	200
Honey locust, 15 to 25 feet high	500
Gray willow, 30 to 40 feet high	500
Hackberry, 6 to 10 feet high	500
Soft maple, 12 to 20 feet high	1,000
Coffee bean, 4 to 6 feet high	3,000

"Ellinwood, the next point, is 40 miles farther west; elevation, 1,750 feet; soil, a black, sandy loam, with a tenacious subsoil. Here are now growing—

Soft maple, 16 to 20 feet high	600
Honey locust, 15 to 20 feet high	400
Catalpa, 15 to 20 feet high	1,800
Box-elder (ash-leaved maple), 15 to 18 feet high	500
Ailanthus, 18 to 20 feet high	300
Osage orange, 12 to 15 feet high	2,000
Cottonwood, 30 to 40 feet high	2,000
Green ash, 12 to 15 feet high	1,500
Black walnut, 12 to 18 feet high	4,000
Gray willow, 25 to 30 feet high	600
Hackberry, 8 to 12 feet high	400
Elm, 15 to 18 feet high	500

"Garfield, the next point, is 43 miles west of Ellinwood; elevation, 2,100 feet; soil, light loam. The following trees are growing here:

	No. of trees.
Cottonwood, 20 to 30 feet high	4,000
Box-elder, 12 to 15 feet high	2,700
Ailanthus, 15 to 18 feet high	5,000
Black walnut, 12 to 15 feet high	4,000
Soft maple, 12 to 15 feet high	800
Catalpa, 10 to 14 feet high	500
Honey locust, 15 to 20 feet high	400
Green ash, 3 to 12 feet high	2,000
Gray willow, 20 to 25 feet high	200

"The above is a brief description of the results of our work down to the present time. All of these trees have been grown from seeds and cuttings. The conditions have been such as to put the trees to severe tests. There has been no extra work done with them. They have been simply planted and cultivated well. It has been stated that we irrigated a part of our ground. This is not the case. Our trees never received any water except what fell from the clouds. All of these trees at the present time show a promising and healthy appearance, with all prospects of making a rapid and mature growth in the future. This work has demonstrated beyond any question of doubt that trees will grow here with all success whenever planted intelligently and cultivated and taken care of as they should be."

It will be seen that the Atchison, Topeka and Santa Fé Company went no further than experiment to demonstrate that the growth of trees was possible in the region traversed by its line. The same was true of the Kansas Pacific, now the Kansas Division of the Union Pacific. Several experimental gardens or nurseries were started under the direction of the company, but abandoned years ago. Settlers in the same counties where these experimental groves were planted have, on hundreds of timber claims, settled the point at issue.

The Burlington and Missouri River Railroad, in Nebraska, carried on some experiments for a short time, in the way of planting trees along cuts for snow fences.

The Missouri River, Fort Scott and Gulf Railroad Company has entered upon the work of forestry proper; that is, the raising of trees for actual use.

R. Douglas & Son, of Waukegan, Ill., have a contract with this railroad, which runs from Kansas City south, in Kansas, near the line of Missouri, to and beyond Fort Scott, Kansas, to plant two sections of land in trees. One of these is located at Farlington, and the other at Hunnewell, near by. These places are about 125 miles south of Kansas City, Mo. Of the Farlington plantation Mr. Douglas, under date of October 24, 1882, writes:

"Three hundred and twenty acres are planted, and we are now planting 180 acres more. That will be finished before winter sets in, or before April 1, 1883. The plantation consists of catalpa (*speciosa*), with the exception of a few acres. They are all planted 4 by 4 feet apart, containing 2,720 trees to the acre. The land is prepared same as for corn, and the trees are planted with spades. The catalpa trees planted in 1878, after four summers' growth, are 10 to 15 feet high and 2½ to 3½ inches in diameter. Three years planted, 5 to 9 feet; two years planted, 3½ to 6 feet (a drought last year); one year planted, 3 to 4 feet. On rich land these trees shade the ground after two years' cultivation. On poorer land they require three years' cultivation.

"On the Hunnewell plantation, 3 miles from Farlington, we have already planted 175 acres catalpa (*speciosa*) and ailanthus, and 60 acres of the white ash. The catalpa are one and two years planted; we will have 285 acres on the above plantation between now and April next, all catalpa and ailanthus, making 560 acres on the Hunnewell plantation. Our contract requires 2,000 trees to the acre when they are 4 to 6 feet high. Nearly every acre on both plantations will contain 2,500 trees; every acre will contain over 2,000 trees."

Besides the Missouri River, Fort Scott and Gulf, the only other railroad company reported as engaged in forestry is the Saint Louis, Iron Mountain and Southern. Mr. Kerrigan, superintendent, writes:

"We have no trees planted on our road excepting 50,000 catalpa trees on right of way near Charleston, Mo. We have a plantation or farm of catalpa trees (100,000 trees) on Belmont branch, 18 miles from Belmont, Mo. The above were all raised from seed. We also have a catalpa farm of 250,000 trees at Bertrand, Mo., about 20 miles from Bird's Point, on the Cairo branch of this road. These were planted in June, 1880, from slips. Have been cultivated twice, and are now in fine, thrifty condition. Will average about 8 feet high, and will not require any cultivation after next year."

THE TIMBER-CULTURE ACT.

The General Government, acting through Congress, has confined its encouragement of forestry mainly to the passage of the timber-culture act, which grew out of the homestead law and is designed to be supplementary to it. The original Congressional

timber-culture act became a law March 3, 1873. It was amended March 13, 1874, and was on the 14th of June, 1878, changed to the shape it now bears, and since the date of its last amendment most of the entries under the law have been made. That is, the law has been in practical, extensive, working operation but four years.

As showing the extent of operations under the act, the following table, furnished by Hon. N. C. McFarland, Commissioner of the General Land Office, is given:

Statement of the number and area of entries under the timber-culture laws in the different States and Territories, by fiscal years, from the beginning of operations to June 30, 1882.

States and Territories.	1873.		1874.	
	No. of entries.	Acres.	No. of entries.	Acres.
Arizona			2	196.51
California	2	329.75	59	8,878.06
Colorado			17	2,272.24
Dakota	24	3,560.00	865	124,997.29
Iowa	1	145.90	33	3,816.05
Kansas	60	9,642.17	1,954	282,479.07
Minnesota	95	14,710.15	804	113,131.63
Nebraska	137	21,858.07	2,164	312,712.09
Washington			22	2,482.22
Wyoming			1	80.00
Idaho			2	180.83
Total	319	50,246.04	5,923	851,225.99

States and Territories.	1875.		1876.	
	No. of entries.	Acres.	No. of entries.	Acres.
Arizona	2	320.00	10	1,197.15
Arkansas			3	231.92
California	195	29,065.53	136	20,524.33
Colorado	27	3,453.82	45	6,514.22
Dakota	451	61,969.75	842	119,835.23
Iowa	92	9,127.52	99	8,563.42
Kansas	1,265	168,269.06	1,354	185,596.43
Minnesota	499	63,673.73	1,070	140,126.30
Nebraska	1,061	130,894.26	834	106,499.74
New Mexico			7	1,128.00
Oregon	7	882.68	13	1,793.18
Utah			3	399.88
Washington	31	3,324.14	54	5,374.28
Wyoming	1	130.47	1	160.00
Idaho	21	2,583.25	17	1,973.89
Total	3,652	473,694.21	4,488	559,917.97

States and Territories.	1877.		1878.	
	No. of entries.	Acres.	No. of entries.	Acres.
Arizona	21	2,440.00	11	1,600.00
California	75	10,586.05	60	8,029.42
Colorado	28	3,343.23	125	17,436.73
Dakota	476	68,266.92	3,769	579,804.04
Iowa	59	4,791.56	89	7,535.47
Kansas	1,666	238,020.44	4,031	593,295.17
Minnesota	561	76,021.53	2,693	377,017.78
Montana	3	398.59	9	960.00
Nebraska	706	90,812.90	1,408	195,306.68
Nevada	2	240.00	5	600.00
New Mexico			2	320.00
Oregon	19	2,509.37	130	18,446.31
Utah	3	338.59	9	1,280.00
Washington	148	19,746.75	562	78,237.00
Idaho	52	7,035.91	158	22,169.53
Total	3,819	524,551.85	13,061	1,902,038.03

Statement of the number and area of entries under the timber-culture laws, &c.—Continued.

States and Territories.	1879.		1880.	
	No. of entries.	Acres.	No. of entries.	Acres.
Arizona	21	3,280.00	6	719.65
California	112	14,458.81	99	12,120.31
Colorado	121	16,142.03	214	30,302.14
Dakota	4,675	728,687.83	5,575	868,748.39
Iowa	73	6,577.67	57	4,714.05
Kansas	7,776	1,167,582.77	2,891	408,261.74
Louisiana	1	80.43	1	40.00
Minnesota	1,847	257,642.50	909	123,735.36
Montana	27	3,134.20	61	6,835.32
Nebraska	3,183	465,968.94	3,202	475,275.87
Nevada	1	160.00	5	560.00
New Mexico	14	1,891.93	24	2,887.95
Oregon	130	18,446.21	482	73,061.66
Utah	9	1,280.00	35	4,044.05
Washington	562	78,237.00	893	134,637.65
Wyoming			9	240.00
Idaho	162	22,013.93	181	23,300.04
Total	18,629	2,775,502.66	14,644	2,169,484.18

States and Territories.	1881.		1882.	
	No. of entries.	Acres.	No. of entries.	Acres.
Arizona	6	760.00	9	1,352.77
California	201	24,538.28	306	39,882.99
Colorado	195	26,473.31	329	47,436.05
Dakota	5,134	868,400.36	9,368	1,466,532.34
Iowa	55	3,644.25	82	6,235.62
Kansas	1,924	268,575.09	1,933	273,053.55
Louisiana	19	2,293.40	7	1,004.02
Minnesota	1,168	167,582.16	1,220	176,741.42
Montana	131	16,535.20	266	35,409.94
Nebraska	1,682	240,306.94	2,086	298,520.11
Nevada	7	1,040.00	10	1,520.00
New Mexico	16	2,039.26	24	3,351.99
Oregon	212	31,176.40	590	88,038.77
Utah	35	3,921.52	32	3,831.71
Washington	540	77,008.62	603	87,524.76
Wisconsin	1	40.00		
Wyoming	5	784.30	20	2,284.44
Idaho	224	28,680.26	272	33,965.61
Total	11,554	1,763,799.35	17,157	2,566,686.09

By this table it will be seen that, since the passage of the original act, in 1873, 93,246 filings, covering 13,637,146 acres, have been made. Of that amount there have been entered since the passage of the amended law, in 1878, 11,177,510 acres.

Of this amount of 13,637,146 acres on which timber filings were originally made, it is safe to say, from information received from various Government land offices in the prairie States and Territories, that at least one-third has, for various causes, been canceled or entered under other acts, leaving, say, 9,000,000 acres held for the present under the provisions of the timber-culture act.

Before giving an opinion as to the practical operations of the law, attention is called to the statements of those who, from official position or other circumstances, may be supposed to have the best opportunities for practical observation of the workings of the act and the amendment it needs to make it more efficient. Hon. Charles A. Morris, register of the United States land office at Larned, Kans., writes:

"I have to state, in reply to your letter, that there have been made at this office, since it opened for public business, February 15, 1875, 1,611 timber-culture entries, embracing about 700,000 acres, and of these entries there have been canceled by contest and voluntary relinquishment about one-third, embracing about 233,000 acres.

"The object of the timber-culture law is to encourage and foster the growth of timber on the western prairies, and the fact that it is not more generally successful is owing to the traffic in 'claims,' entered under its provisions by claimants who ap-

propriate public lands under this law for speculative purposes, and when opportunity offers, sell to homestead and pre-emption settlers; thereby not only defeating the object of the law, but forcing the newcomer to pay a bonus to secure a desirable location for a home which he otherwise might have obtained at a minimum cost, to wit, the Government fees. This evil can be remedied and the law made effective, and the growth of forest trees on the western prairies assured, by so amending the timber-culture act of June 14, 1878, as to provide that land once entered under its provisions be ever afterwards appropriated thereunder, and not subject to entry under any other law. I would suggest that section 3 of the timber-culture act, approved June 14, 1878, be amended as follows, viz:

"'*And be it further provided*, That lands once appropriated under this act shall not, in case of the cancellation of a timber-culture entry or from any cause, be subject to entry under any other law, but shall be only subject to entry under this act.'

"An amendment of this kind would stop speculation of the nature I have stated, and, in my judgment, insure, beyond question, the successful growing of timber in Kansas, for land once entered under this law would be thereafter forever dedicated to the successful growing of timber, and title could only be obtained, be he original claimant or otherwise, by making the growing of timber a success, and it has already been demonstrated that timber can be successfully grown, even in western Kansas, by honest and intelligent effort."

E. A. Knidler, register, and C. H. Gould, receiver of the United States land office at Miles City, Mont., present some valuable ideas about the operations of the timber-culture act in the following letter:

"We would state that the intention of the act is excellent. Theoretically the law is good, but in the practical application of the same it has proved very faulty.

"It is an excellent law for speculators in prospective town sites, as one person at least in eastern Montana has discovered, said person taking up a 'tree claim' at the cost of $14, and, before expending one penny for breaking, even, received $5,000 for his relinquishment.

"We are of the opinion that out here nine persons out of ten, who make timber-culture entries do not expect to ever plant a cutting, slip, or to sow a seed of a tree.

"The lands most sought after in this land district are the bottom lands along the Yellowstone, the Tongue, Powder, and Rosebud rivers, and nearly every section along and skirting those streams contain more or less timber. The average speculator endeavors to take the best bottom lands and with just as many trees upon the section, and frequently upon the tract actually entered under the timber-culture laws, as they dare or can: they hold the land a year or two, and then, if it is not contested as fraudulent, they relinquish their entry, asking that their right and fee and commissions be returned to them, upon the ground that the entry cannot be confirmed, the land not being subject to timber-culture entry. There has not been to our knowledge a cutting, seed, or a tree planted upon a timber-culture claim in this land district, but cottonwood trees have been planted in the yards and streets in town, and nearly all have grown, although the ground has never been prepared or cultivated. In our opinion, trees can be successfully raised upon prairie land by careful and intelligent care and culture.

"We think the present timber-culture laws should be repealed or amended as follows, viz:

"1st. The applicant should be required to swear that he personally examined the whole section of 640 acres, finding the corners of the same, and that there is not at the date of the affidavit, and apparently never has been, upon the said 640 acres any trees, shrubs, or brush growing thereon, excepting ——— (describing the growth). This would enable the local officers to judge by the affidavit as to the character of the land. Under no circumstances should the applicant be allowed his right and fee and commissions restored to him.

"2d. When a tract of land has once been withdrawn by a timber-culture entry it should not thereafter be subject to homestead, pre-emption, scrip location or cash entry, provided the land should be properly subject to timber-culture entry. Nor should more than three timber-culture entries be allowed for the same tract, the former entry having been canceled for relinquishment, or upon proof of non-compliance with law after contest. The tract thereafter (the three timber entries have been made) to become the property of the State, upon proof of compliance with the requirements of the timber-culture laws on the part of the duly authorized agent for the State.

"This, we think, would stop speculators from taking timber-culture claims, and would have the effect of eventually establishing ten acres of good timber upon every even-numbered section of United States lands, the same being prairie land.

"3d. The amendment of the act, whereby the same commissions and fees are to be paid by the applicant as would be required under the homestead laws for the same tract.

"Under the homestead laws the applicant for 160 acres of double minimum land in Montana, and ten other States or Territories, is required to pay at date of entry $10

fee to the United States and commissions to the local officers of $12, and the same commissions for the local officers at the time of proving up under the homestead law, viz, $12. Under the timber-culture laws the fee to the Government is the same, but the commissions to the local officers are only $4 to be paid when entry is made, and $4 to be paid when the proof is made; making a loss to the local officers of $18 for each 160 acres taken under the timber-culture laws.

"Thus the law as it now exists virtually offers a premium, and makes it a great object to local officers where the maximum is not attained (and those are in the majority) to discourage timber-culture entries. We do not think the timber-culture laws strong enough to carry so heavy a weight; they are too heavily handicapped.

"We may be too strong in our suggestions too suit you, but the above are our honest opinions."

Loren Listoe, register of the United States land office at Fergus Mills, Minn., says:

"The timber-culture act by no means has proved to be of so great a benefit to the public as had been expected; still I would consider it a great calamity and a serious mistake if said act should be repealed. It is true that a great number of acres have been entered by speculators under said act, who, for instance, hold it two or three years and then sell their rights to other parties. But on the bleak prairies of this State and Dakota I know of a great many claims which have been entered by parties, actual settlers, who honestly try to carry out the provisions of the act."

Hon. J. V. Bogert, receiver of the United States land office at Bozeman, Mont., speaking of relinquishments under the timber-culture act, says:

"It is my opinion that speculation, expense, and labor mainly caused the relinquishments. I do not conclude that the relinquishments, to any extent at least, are caused by the failure of trees to grow, if properly cared for.

"It is my opinion that the time given in which to perfect an entry is too long; it encourages speculation in public lands, enabling parties to hold them eight years, in very many cases without planting a tree. Contests are not so often brought; parties do not like to antagonize neighbors; while the fact that inclosed or cultivated land has been taken under the timber-culture law may be, can be, and no doubt often is, concealed.

"I see no reason why parties should not be obliged to plant a certain area in trees, and during the first continuous summer succeeding their filing, if made *during* a summer, and during the summer succeeding filing if made *prior* to a summer. I do not notice any necessity for the first year's plowing and the second year's cultivation, if I am to judge from local success with trees without said work and use of time. Of course, I know that trees require care and ground preparation, but, were said two years not given, more compliance with the law would follow and less speculation in entries result. Again, at stated times during pendency of each case, parties should be obliged to appear at the local land office and prove compliance with the law. This would force compliance or relinquishment, and do away with eight years' withdrawal of much land."

W. E. Powell, the general agent of the Chicago, Milwaukee and Saint Paul Railroad, writing of the workings of the timber-culture act, and referring particularly to the Territory of Dakota, says:

"The tree-claim law is shamefully abused in that Territory. While it was made for the benefit of the actual settler, there is no chance for him to get a tree-claim at all. They are all taken up in each township by speculators in less than twenty-four hours after the township is in market. They file them under fictitious names and hold them until a settler comes and buys them for $300 or $400 each, but, if they cannot sell them before improvements must be made on them, they relinquish them to each other or to some unknown parties, and get new filings on them, and they can keep them so many years without any planting whatsoever, thus circulating reports among the ignorant that trees will never grow on prairie land. We will prove to the contrary."

D. S. Hall, register of the land office at Benson, Minn., says:

"I have no doubt that the timber-culture law is, and has been, a cloak for covering large tracts of good land by parties who have no idea of ever complying with the law, as far as planting trees is concerned; but a slight amendment to the law, requiring the parties to promptly and strictly comply with the requirements thereof, would remedy the evil and stop the fraud."

D. S. Grimes, a gentleman of great experience in tree growing, and for many years a resident of Denver, Colo., writes:

"With the timber-culture act as it now stands, the incentive to planting is to secure title. The claimant does as little as possible to comply with the requirements of the law; he has no pride or sympathy with his work, only as refers to obtaining title. The planting, protection, and healthy growing of his trees for eight years is sworn to by interested and accommodating neighbors, hence this act is often taken advantage of. To repeal this act would do the West great injustice. It should be amended so as to compel a faithful performance of the contract on the part of the claimant Instead of one entry of 160 acres to each section there should be two entries allowed,

not to exceed eighty acres each upon a section of 640 acres to be planted to timber in the same proportion as provided for in 160-acre tracts. The advantage of dividing 160 acres into individual timber entries can plainly be seen:

"1st. The timber is in two plantations instead of one, and perhaps located in opposite parts of the section, and will be benefiting twice the number of settlers.

"2d. One hundred and sixty acres are too much for a man of limited means to cultivate successfully; the area of land being so much greater than his ability to control, neglect and failure will result.

"A State or district forester of practical experience should be appointed by Government, whose duty should be to give information free to all applicants upon the subject of forest culture. In making final proof on a timber entry the forester should first make a personal inspection of the lands claimed under the act, and if the law has been fully and faithfully carried out, then his certificate should be sufficient evidence that the law has been complied with. This will not only compel the party claiming land under the timber-culture act to be thorough in planting and cultivating, but will save to the Government thousands of acres annually that would otherwise pass into the hands of dishonest claimants."

Mr. D. Pratt, an old resident of the plains country, sends the following suggestions:

"I would first repeal the acts granting lands for timber culture and for pre-emption claims, and permit claims to be taken only under a modified homestead act. The changes I would suggest in the homestead act are as follows: I would allow a settler to take any number of claims he chooses, up to one section, 640 acres, with this proviso, that on each and every quarter section granted him he should plant, cultivate, protect, and maintain 16 acres of timber across either the entire north or south side of said quarter section. The planting I would require to be done in the following manner, viz: Previous to the first day of June next succeeding said homestead entry, he should break across the entire north or south side of each quarter-section not less than 4 acres. And previous to the first day of each succeeding June, for three consecutive years thereafter, 4 acres more, or until 16 acres are broken. The first 4 acres should be planted within two years, or the second spring after the land is broken, and 4 acres more planted annually thereafter until the 16 acres are all planted. The land should be thoroughly cultivated the year previous to planting, and each succeeding year, till the trees are at least six years old. I would make the cultivation of the land thus granted, other than the 16 acres above specified, entirely optional with the grantee, but would require an actual residence on the land, which the timber-culture act does not."

S. M. Emery, of Lake City, Minn., says:

"My personal observation in tree-planting has, in the main, been confined to the portion of the West contained in Western Minnesota, Northern Iowa, and Eastern Dakota, where many farms have been taken under the timber-culture act. These apparently have not always been successful in the production of timber, not from any constitutional difficulty in the soil, but from force of circumstances, and these mostly arise from the inability of the pioneer settler to obtain suitable stock for planting, the lack of knowledge as to culture, and lack of means to give the land suitable cultivation. I have seen some very fine groves of artificial timber, mainly white willow and cottonwood. There is nothing in the working of the law that prevents the growth of timber. Land well broken and backset the first season, cropped to flax the second season, this cut, and the land plowed and harrowed thoroughly in the fall, immediately after harvest, and then planted to either box-elder seed or hardy seedlings, and then the same care given the crop that a good crop of corn should receive, will surely produce a magnificent growth of trees. This I know for a personal fact, having had the management of five timber claims aside from my own. The number of claimants who have proved up is small beyond doubt, as it is not a law of long standing. That there are frauds under the law we do not doubt, but it is fashionable now-a-days to do this. If millions of acres of valuable pine timber can be stolen under the pre-emption act, it would not be strange if fraudulent proofs may be made on timber claims. I have thought much over the best way for Government to manage the timber-claim filings. It does not seem right for a man to cover 160 acres for three years, then relinquish to some other party who can do the same thing, and thus indefinitely cover and hold a piece of land. Again, the law is much abused in the planting of seed. It would seem advisable to me that a claimant in case of contest for non-compliance with the law, who should base his defense on having planted seed which did not germinate, should be made to show, by at least four witnesses of unimpeachable veracity, that the seeds were actually planted, and that a series of as formidable questions and answers as are needed for proof paper should be used to prove his defense. This would work no injury to innocent parties, and would certainly have the effect of making men careful. I think the law should plainly state that 27,000 trees should be planted on 10 acres in rows eight feet apart, trees two feet apart in the rows. This will admit of crop cultivation in half the soil and will leave trees in better shape for trimming. I think an annual cultivation should be required for at least six years of

the eight. It might be worthy of consideration, the idea of allowing a man to commute at the end of the fourth year from filing, provided he can prove the existence of 625 good trees on each of 10 acres by payment of $1.25 per acre. The effect of all this would be to open up that much more land. Of course no purchaser would destroy so valuable a property as 10 acres of growing timber. * * * I am sanguine that we will yet see our bleak prairies dotted with noble clumps of timber, the result of the act."

It will be seen that the testimony of these witnesses, Government officials, and others, is uniform. They all state that in many instances the law fails of its main object, the extension of the forest area of the country. The great evil pointed out by all of them is everywhere the same, viz, the sale or transfer of timber claims by the original claimants to speculators and other parties.

We have already called attention to the fact that of the 13,000,000 acres filed under the timber-culture law, at least one-third has been canceled or entered under other acts. It is safe to say, with the statements herein given before us, that within a brief period, unless the law is amended, a large portion of the 9,000,000 acres remaining will be diverted in a similar manner. Admitting that the law is defective and that men are dishonest, and that they perjure themselves in regard to timber-culture claims just as they frequently do in regard to the homestead filings, is it proven that the law utterly fails of its intention; that it has accomplished no good purpose, or that it cannot be made to do so? The testimony does not show this. None of the land officers or others whose observations we have given recommend the absolute repeal of the act; they simply recommend its amendment and its enforcement. The objection made that natural causes make compliance with the law impossible, in other words, that trees cannot be made to grow with proper care, is nowhere sustained. On the other hand, the evidence is overwhelming that in all the country between the Mississippi and the Rocky Mountains trees will grow under cultivation, and that no man can yet say where the line is located beyond which forestry is unprofitable.

From a mass of letters and reports from all parts of this vast region we give the following:

B. P. Hanon, of Reno County, Kansas, writes:

"In every instance in our knowledge where suitable varieties have been planted and properly cared for afterwards, they have grown well and proved satisfactory."

Mr. E. E. Ballou, of the United States land office at Helena, Mont., says:

"I am fully satisfied that cottonwood, balm of Gilead, and box-elder, all of which are native, can and will be cultivated successfully here. The silver-leaf poplar also grows quite as thrifty as any of them. I should much regret the repeal of the timber-culture act, for I think it will prove a great blessing to this as well as other Territories if continued."

Mr. D. S. Hall, register of the United States land office at Benson, Minn., says:

"No person who knows anything of western prairies will deny that planting trees thereon is the very thing of all others to make it a place to be inhabited by man. I speak from years of personal experience when I say that it is perfectly natural and easy for trees to grow on these western prairies. Where prairie fires are kept from running, groves of trees spring up at once. I know of a grove of heavy timber, containing 60 acres, which stood in the center of the prairie, miles from any other timber, in Renville County, this State. This grove was almost surrounded by water, which protected the land from the ravages of fire. It was called Bird Island. I could refer you to any number of illustrations to show you that trees will grow on these prairies if you will only let them, and also that by the slightest effort nearly all of the valuable timber-producing trees may be successfully grown out on the prairies."

The evidence of E. T. Byram, county surveyor of Jewell County, Kansas, is to this effect:

"If any one has any doubt about this matter he has only to pass through this and adjoining counties and see the beautiful small groves and windbreaks of different varieties of forest trees to be fully convinced that trees will grow on the prairies 200 miles west of the Missouri River. There has no doubt been a great deal of deception and fraud practiced in regard to timber entries; but the same may be said in regard to homesteading. I do not know how these evils can be remedied, but I do know that, although I have less than three years remaining of my threescore and ten, yet if I needed to do so I would plant forest trees with an abiding trust that I would live to reap the benefit of my labor, and that in less than ten years I would have all the fuel I would need year in and year out."

Loren Listoe, of the United States land office at Fergus Mills, Minn., gives his opinion as follows:

"In this land district but three timber claims have so far been proved up; upon all of these the trees were in good condition, and one of them which I have myself inspected presents to-day as fine an appearance as if it was a regular nursery, composed of cottonwood, ash, and white willow; the trees are from 12 to 20 feet high, and some of them fit to be used for fence-poles to-day. I think it can be safely said that any

man who will prepare his ground properly, and cultivate the trees after they are planted, can raise timber successfully in this State, and in Dakota, where I am acquainted."

T. G. Clark writes from Osage County, Kansas, a hundred miles west of the Missouri River:

"Tree-planting on the prairies is no longer an experiment, but a successful business. The time has come in the history of this nation to encourage the planting of forest trees, and I think it unwise to repeal the timber act. I think the law should not restrict the planting of every valuable variety of trees, but let the settler plant such kinds as will succeed best."

FORESTRY AND IRRIGATION.

It is asserted that a vast portion of the interior country of the continent, including portions of the States of Texas, Kansas, Colorado, and the Territories of Dakota, Wyoming, and New Mexico, cannot be cultivated without irrigation, and this brings up the very natural question, why should they not be cultivated with it? It is admitted that forests affect the rainfall, or at any rate the general humidity of the atmosphere; why should not the rule be made to work both ways, and forests be sustained by the water now available, even in the most arid portions of the country, and the forests, on the other hand, be made to preserve and increase the supply of moisture?

The great open, high, and dry country of which we are writing, estimated in extent at three hundred miles wide and eight hundred miles long, is not naturally unfertile. It is not a sandy desert, or a rocky waste, of no intrinsic value for agricultural purposes, but the soil for the most part is a rich loam, possessing the constituent parts of rich tillable soil.

The country is not entirely destitute of water, by any means; it is traversed by the Canadian, the Arkansas, the upper waters of the Kansas, the North and South Platte, the Rio Grande, the Nebraska, the Cheyenne, and many such streams as the Cache La Poudre. These streams are alike in their character; each has a wide, shallow bed, shifting channels, swift currents, and a fall of from seven to ten feet to the mill. The banks are very low and the valleys wide, and with a descent to the eastward corresponding to the fall of the streams.

With water, and a fertile soil which only needs water, why should not the two be brought together? This is, briefly, what may be termed the "irrigation question."

To consider the difficulties, first, it is said that the streams mentioned cannot be depended on to furnish the requisite amount of water at the season when it is needed. To this objection it is answered that there is every natural facility for the construction of immense reservoirs for the storage of water during the winter and the portion of the year when there is a surplus; and, further, that the great plateau is traversed by subterranean streams which may be reached by digging. The surface streams, which seem to dry up at some seasons, merely sink into the sand, and the fact is called to mind that in 1859–'60, the driest season ever known within the memory of man, when in the country west of the Missouri no rain fell during a period of nearly twelve months, water was found by digging in the beds of these streams.

The best and safest rule in endeavoring to ascertain whether a thing can be done is to secure an answer to the question, "Has it been done?" Applying this rule to the irrigation question it will be found that irrigation has been successfully carried on along the banks of the Rio Grande for the three hundred years that the country has been known to white men, and for indefinite centuries before the Spaniards landed in North America. The irrigating ditches in the valley of the Pecos may have been dug when the pyramids were young.

The results of irrigation carried on by an imperfectly civilized and unprogressive people, with the rudest implements, may be seen from the point where the Rio Grande leaves the mountains, for hundreds of miles; and amid a land which elsewhere seems cursed with eternal sterility, winds the green belt of trees and orchards, of fields and vineyards watered by the Rio Grande or its tributaries, from the garden of the archbishop of Santa Fé to the mass of verdure which enfolds the old New Mexican town of Las Cruces.

This is the work of a people with no scientific knowledge of hydraulic engineering, carried on with hoes and plows such as were in use in the days of Abraham. Can no more be done by Americans than by New Mexicans and Indians? Are the resources of modern agriculture inferior to the unchanged inventions of a Pueblo Indian? Must we abandon a country to desolation which Mexican peons have found capable of cultivation.

Answers in the negative are not wanting. Not to speak of the wonderful success achieved by the Mormons at Salt Lake, the scene of which is outside of the region which is properly to be discussed in this report, there may be cited what was once known as the "Greeley experiment," which is an experiment no longer. Saying nothing of the success in the direction of farming and gardening which has made the Greeley community one of the most prosperous in the United States, the growth of

trees has been enormous. The cottonwoods planted in the early days of the colony are giants in size now, and other trees are growing finely and will eventually take the place of the "pioneer tree." Not far from Greeley is Fort Collins, the seat of the agricultural college of Colorado, and of the success of tree culture there, P. M. Hinman, the secretary of the college, writes:

"In regard to the growing of the trees in this region, I will say that there has been a large growing interest taken in the past few years, and trees are being put out very extensively; I know of some walnuts in bearing and others being planted. Should think that the next ten years will find a very rapid increase both in amount of land devoted to the growth and the kinds planted."

This is but one case. At various points in Colorado and in Wyoming irrigating ditches, to be in some cases 60 miles in length, are in course of construction. Wherever these ditches run, trees will grow transforming the face of the country. It has been noticed, too, that in abandoned ditches young cottonwoods spring up by thousands, the presence of water the year before seeming in some manner to promote their growth.

At Garden City, Kans., near the borders of Colorado, on the line of the Atchison, Topeka and Santa Fé Railroad, irrigation has been begun on a scale which bids fair within a few years to be the most extensive within the limits of the United States. The source of supply here is the Arkansas River, and the fall is so great that the water taken from the river twenty miles above Garden City, when it reaches that point, can be carried over the high plateau known as the "Second Bottom," and so an immense area is embraced within the possible limits of irrigation.

With the first beginnings of cultivation trees were planted, and their growth has been surprising. This much has been demonstrated, that there is nothing in the character of the soil to prevent a tree growth as luxuriant as can be found anywhere within the limits of the United States.

The theory that the high plains were once covered with forest, and that at a not remote period, is sustained by some remarkable facts. It is certain that the trunks of large trees are found in the bluffs or hills, miles from the water-courses, and that not many years ago these giants of a century's growth were quite numerous.

Long before the settlements had encroached upon these plains, the Arkansas, the Platte, and other streams were skirted with timber which gradually disappeared as you traveled westward. These same streams were supplied with considerable bodies of timber from the mountains eastward. The intervening distance from where the timber disappeared on the east to where it again begun on the west was perhaps two hundred miles, although in the adjoining bluffs, at points where no trees or even brush was found along the streams, bodies of old trees were found and used extensively for firewood.

The digging of irrigating canals is the signal for a heavy volunteer growth of timber along their borders, the cottonwood, the willow, and the elm predominating. Forest trees planted by the settlers or ranch-men upon the bottom lands at any point between the Missouri River and the mountains seem to live and flourish without further attention. All plains-men remember the immense "lone cottonwood" tree that stood for a century, far removed from the Arkansas River, in the vicinity of Fort Dodge, Kansas. For years large supplies of cedar were found in the hills near Julesburg, Nebr., not far from the confluence of the North and South Platte Rivers; this timber was used extensively by Ben Holliday's overland stage line even as late as 1865.

The average annual rain-fall of this great plain, which extends from the Territory of Dakota to the Rio Grande, does not exceed 12 inches. Although it is claimed that timber will not grow in a region where the annual rain fall is less than 20 inches, and although it may be argued that the great plains are treeless, because they are rainless, and not rainless because they are treeless, people who have lived on the eastern border of the great desert for the last quarter of a century, and noted the climatic changes wrought in that time, and who have seen this border pushed westward several hundred miles, have faith to believe that not only will the civilization of the Missouri Valley, fostered and sustained by modern forms of agriculture, be met from the west by that sustained by artificial water supply, but that the nineteenth century will witness the highest forms of horticulture and agriculture successfully practiced upon an unlimited scale in the very heart of this now treeless and rainless desert.

KNOWLEDGE IS POWER.

The great gain so far made is that of knowledge, and to this great gain every discussion, every report, every experiment, every success, every failure even, has contributed. The too enthusiastic have learned moderation, and the despondent have been encouraged. No man who has looked over the ground will maintain that all kinds of trees will grow in the high prairies and plains that grow in lands of mists, rain, and mountain, and, on the other side, no thoroughly posted and practical prairie farmer or plains man will say that trees will *not* grow even in the constantly diminishing precincts of the "American desert."

SUITABLE VARIETIES.

It has been decided what trees grow best in the prairie States, and a hundred tree planters selected from different localities in the States and Territories embraced in this report, would, if called upon, report the same varieties. They are the ash, black walnut, box elder, cottonwood, honey locust, Osage orange, silver maple, catalpa, Russian mulberry, white elm, and gray willow. It is not to be understood that no other forest trees will grow; many other trees are indigenous; but it is to be understood that where a selection is to be made, these trees are most available. In selecting others the chances of losing time and money are increased.

PROPER METHODS OF CULTIVATION.

In addition to this useful knowledge, certain points have been reasonably well settled in regard to the cultivation of these trees, and we give these directions in the language of one of the most successful foresters in the country, Mr. C. H. Longstreth:

"Trees should be planted closely, for immediate and mutual protection; second, for economy in culture; third, for the purpose of securing valuable timber and early returns from the planting. There evidently was a want of practical knowledge with our law-makers on this question when they framed and passed the timber act allowing trees to be planted 12 feet apart each way. Trees planted such wide distances can never serve the purpose of a forest, but will virtually become an open orchard.

"*Propagation.*—As a general rule the best and cheapest mode of growing trees for timber is by means of the seed; some kinds, such as the cottonwood, the willows, and most of the poplars, may be readily propagated from cuttings.

"*Preparing the ground.*—In preparing the soil for planting of seeds and young trees it is essentially necessary that the ground should be deeply plowed and well pulverized.

"*Distance apart.*—We have practiced planting in rows 4, 6, 8, and 12 feet apart, with trees 2 to 3 feet apart in the row, the results so far being in favor of rows 4 feet apart. Trees that naturally grow upright may be farther apart than those of a spreading habit. In no case would we recommend putting the rows over 6 feet apart.

"*Planting.*—Seeds that start with a delicate growth should be planted in nursery rows, or in a seed bed, to be transplanted to the forest at one or two years old; seeds and cuttings of a vigorous growth may be planted right out in the forest rows. The nut-bearing trees do not transplant well, and the seed should be planted where the trees are to remain. We would advise, most decidedly, not to allow your trees in nursery rows to get more than two years old before transplanting; and they are better transplanted at one year old. One-year old trees are sure to grow, having, in proportion to the top, more and better small fibrous roots. Young trees cost less throughout in handling and planting, and in the end make a larger, thriftier, healthier, and better tree every way. Be careful not to expose the roots of trees in handling; set them one or two inches deeper than they stood before, and press the earth firmly about the roots.

"*Cultivation.*—To be successful in the growing of trees it is essentially necessary that they should receive good, thorough cultivation. You might just as well expect to grow a crop of corn without cultivation as a crop of trees. Too many people allow their trees to die or be ruined for want of a little care and cultivation, and then complain that tree-growing is a failure. Neglect is a failure everywhere. Cultivate well in the early part of the season; allow no weeds or grass to grow; stop all cultivation with the plow after the middle or last of July, this being done in order to let the trees have time to ripen their wood and be in good condition for the winter; pull or hoe out all the weeds that may come in late in the season. In plowing among trees a short whiffletree should be used to avoid injuring the trees. All trees planted in the spring should be ridged the following November by turning a furrow against them on each side with a light plow; the ridges may easily be leveled in the spring with the cultivator. After three or four years, or as soon as the trees shade the ground, they will need no more cultivation, and will thereafter need but little care. Be careful to keep stock from running among the trees, as they are very injurious, even after the trees attain a large size.

"*Pruning.*—This is a subject that has been much discussed, and in regard to which there are various opinions, some even contending that trees should not be pruned at all. I shall consider it here only in relation to forest culture. When there are more than two leading shoots they should be cut out to one, leaving the largest. Any side branches which detract in size and vigor from the leading shoot should be shortened or cut off entirely. This is all the pruning we find necessary in a closely planted forest; nature will do all other pruning.

"*Thinning.*—Here is where we get our early returns. Several of our rapidly growing trees, if they have been properly planted and taken care of, may, in four or five

years, be thinned out to advantage, care being taken to leave the straightest and most vigorous trees; then thinning gradually as the trees grow larger."

In a convention of nurserymen and tree-growers it is quite probable that there would be found gentlemen to take exception to these rules. It is also true that these directions were given originally for the benefit of Kansas tree-growers; yet Mr. Longstreth's views as to varieties, close planting, and cultivation have been indorsed by tree-growers and men of experience all over the country west of the Missouri, writing without consultation with each other.

THE BEST TREE.

Something has been learned, too, of the relative value of trees. Limited as the list seems, few persons will care to plant them all, and a choice must be made. In making the selection we should advise as the first choice the black walnut. It seems for the first three or four years a slow grower, but after that period it grows rapidly; and admitting that the soft-bodied trees grow faster at the start, they are of little value when grown, while the black walnut has an actual money value greater than that of any other American forest tree. It should be the Western forester's main reliance; but between the walnuts experience has shown that other trees should be planted which put forth their leaves earlier, though they may not be worth so much for their wood, such as soft maples, box elders, or cottonwood. The latter have the farther advantage of compelling the black walnut tree to run up straight and high, and they serve to shelter and protect it from the hot sun and drying winds.

INFLUENCE OF DISCUSSION.

The varieties best for planting and their mode of cultivation having been definitely settled, the next great step is to ascertain and employ the best means to foster and encourage the work of tree-planting. In this direction much has been done. Societies, notably the Forestry Association of Minnesota, have done much, and meetings like those of the American Forestry Congress at Cincinnati and Montreal have excited general interest. It is certain that never before in the history of this country has forestry been so generally a subject of interest among all classes of people.

THE FUTURE OUTLOOK.

It is but nine years since the timber-culture act, the first law of Congress designed to encourage tree-growing, was passed. It is only four years since the law was so amended as to encourage action under it. The first timber claims are now being proved up, and the advantages and demerits of the law are now fully known. The subject has already been discussed in these pages. There can be no doubt that Congress will take action and so amend the law as to prevent fraud, and embody in the law the condition, "once a timber claim, always a timber claim," and so give an immense impetus to tree-growing on the prairies. Thus, with increased and increasing knowledge; with enlightened self-interest, and the Government of the nation pledged to the protection of the forest lands, still the common property of the people, from spoliation, the encourager of the honest settler under the timber-culture act, and in time the active promoter of schools of forestry, we have much to hope for.

WHAT SHOULD BE DONE.

In a country like this, where the power of the General Government is scarcely known or felt, reliance must be placed upon the voluntary action of the individual. In European countries, where the Government regulates everything, even to the amusements of the people, a system of forest laws can be adopted making the planting and preservation of forests obligatory, but such a system cannot be inaugurated here. The Government cannot here compel all men to set out trees or care for them; and it is questionable if it can give much successful encouragement in the way of bounties. On the other hand, the Government of the United States has a right to take care of its own. A quarter-section of land in the prairie or on the mountain side is, until it is conveyed by the Government to a corporation or individual, as much the property of the United States as is the Capitol at Washington, or a fort or vessel flying the flag of the United States. It is as much the duty of the General Government to protect that quarter-section from invasion or spoliation as it is its duty to save the Patent Office or Treasury buildings at Washington from robbers or incendiaries. Of course, the letter of the law recognizes this principle, but no laws have been more systematically violated than those designed for the protection of Government lands. The theory has obtained that these lands belong to the first settlers, and that their product is to be used by them for their own individual benefit, under the plea of "Developing the resources of the country." Every man who has cut cord-wood on the

Government land and sold it and put the money in his pocket has justified his course by saying that the operation "developed" the country and thus increased the value of the Government land itself. Nothing can be more pernicious in theory or practice than this. These lands do not belong to the first settler or the first thousand settlers who may come into their vicinity, nor the first corporation which may gain a foothold. They belong to the nation, which is the trustee for fifty millions of people. A citizen in Maine has as much interest in them as a citizen in Kansas or Colorado.

SPOLIATION OF GOVERNMENT TIMBER.

In regard to the forest lands still the property of the United States, the question has arisen, shall they be protected for the benefit of the country and of generations yet to come, or shall they be reduced to desert wastes for the private benefit of speculators and corporations? Take the case of the Government forest lands in Colorado. Twenty-four years ago the slopes of the Rocky Mountains were covered with the untouched forests sufficient, if properly cared for, to supply the *reasonable needs* of the settler and miner, as contemplated by the law, till the end of time. In the shadow of these forests rose the headwaters of the Rio Grande, Platte, and the Arkansas, and the snow in the deep woods melting slowly, the rise of the streams was gradual and uniform for a long period. To-day these mountains are being left peeled and bare. The mountain side is being converted into a bald, bleak desert, the springs are drying up, and the Rio Grande, Platte, and Arkansas now rise with sudden violence and then sink as suddenly in their dry and diminished beds. In other words, the people of Colorado, Kansas, and New Mexico are having inflicted upon them incalculable injury, and a wrong is being done which, if not arrested, will affect disastrously generations yet unborn.

In return for this devastation of its property the Government receives nothing; its magnificent estate is laid waste, and it gains nothing in the way of recompense. The land is nominally in market at $2.50 an acre in bodies of 160 acres to one individual, but it is not being purchased to any extent. With a view of aiding the poor settler or needy miner, a law was passed some years ago allowing him to take timber for domestic use, meaning thereby, evidently, his personal use, for fencing, firewood, or lumber necessary in the actual construction of his mining shaft. The law was certainly liberal enough, and was so liberally interpreted by the settlers that it was found necessary to send Government agents to the spot to protect the rights of the Government; but since that period the words "domestic use" have been interpreted to mean the right of the "party of the first part" to cut timber and sell to other parties for their use. Under this ruling there were lying in one mountain stream in September, 1882, half a million railroad ties, indicating by their length that they were intended for the "domestic use" of a broad-gauge railroad outside of the limits of Colorado, where the narrow-gauge is the usual standard. This is but one instance. Movable saw-mills traverse the country, using up every tree valuable for sawed lumber; these are followed by the railroad-tie cutters, who take every tree large enough for one tie; to complete the work, charcoal-burners follow, using every stick that is left. We have before us a pamphlet setting forth the advantages of a Colorado town, and therein is the statement that within a radius of ten miles sixty charcoal-kilns are running, with a capacity of 4,000 bushels each per month, and representing a monthly distribution of $30,000. This charcoal is being made from wood belonging to the United States, which receives therefor no compensation of any sort; and, moreover, the actual settler in the vicinity is being deprived of the wood granted him for his own use, and is being forced to go miles for wood enough to cook his food; and last and worst of all, drought and desolation are being invited in order that a few individuals may reap a temporary profit out of the Government.

HOW THE FOREST MAY BE PROTECTED.

The few illustrations offered may serve to give an idea of the situation along the whole eastern slope of the Rocky Mountains, so far as occupied by miners or penetrated by railroads and railroad-tie cutters. It is safe to say that no other government on earth, liberal or despotic, would suffer itself to be thus despoiled; and in this country the offense is greater because it is not the robbery of some prince, potentate, or individual, or class of individuals, but of the whole people. The evil is glaring and evident, and the remedy should be prompt and certain. It is suggested that the most effectual is the *withdrawal of all Government timbered land from market*, and the sale of the timber under Government regulation in such a manner as to protect the forest from extinction. To illustrate, the forest lands might be divided into districts of reasonable extent, each under care of a Government inspector, whose duty it shall be to supervise the forest growth, to bring trespassers to justice, and to see that only such trees are sold as can be spared without detriment, or whose removal would be advantageous, or that no trees below a certain size shall be cut on tracts

designated. It should also be made his duty to exercise oversight of tracts from which the merchantable timber has already been removed, to see that the young growth is not injured, and especially that it be protected from fire. In the beginning, for what is done should be done at once, this duty should be performed by capable and discreet men, without any personal or property interest in the districts committed to their charge; men acquainted with the value of timber and its habits of growth, and, above all, men of incorruptible character.

GOVERNMENT FORESTERS.

To the furtherance of this duty, which is to be perpetual—for it should be understood that the Government forests are never to be destroyed—there should be a body of young, energetic, and practical men educated by the Government, and standing in the same relation to it that the graduates of West Point and Annapolis do, competent, faithful, and fond of their work of preserving to the Government and people of the United States a domain greater in value than all its mines of silver and gold. To raise up this class, there should be established such a number of national schools of forestry as may be found necessary, care being taken that the schools are distributed in the different sections of the Union according to climatic division and the character of their natural forests, as, for instance, the white-pine regions, the Southern pine and cypress country, the regions where the walnut, maple, elm, and deciduous trees are the prevalent growth, and the high prairies and treeless plains and mountain slopes where, most of all, the forester is to find work.

SCHOOLS OF FORESTRY AND EXPERIMENTAL FARMS.

Attached to each of these schools there should be an experimental farm, where every tree known to the United States should be planted, and in certain localities, as determined by their natural dryness and altitude, the methods of irrigation as applied to forest culture should be thoroughly tested.

With these two questions of reforesting the plains—we use the word reforesting because it seems evident that forests once grew on the plains—and also of the possibilities and value of irrigation to be determined, the suggestion has been made to the writer that the General Government should in some manner establish a series of experiments, or rather a continuous test, to scientifically settle the matter. Given a treeless region, eight hundred miles long and three hundred wide, to be reforested, largely by means of irrigation, there should be, in the opinion of thousands of intelligent people, some point selected where on an extensive scale trees may be planted, the different systems of irrigation applied, and results noted, and this through a series of years. This would settle, perhaps, that in some districts, generally embraced in the arid region, trees may be grown *without* irrigation. This is the opinion of Mr. D. S. Grimes, of Denver, a gentleman of vast experience. Mr. Grimes believes that trees planted in "dead furrows" and mulched will in four years shade the ground sufficiently for their own protection. This theory might with others be tested to the great benefit of all concerned. In the Western country individual scientific interest combined with munificence cannot be relied upon to establish and maintain such an institution as a school of forestry and experimental farms. The land-grant railroad companies may in time plant forests to test the capability of their lands or to raise trees for their own use, but they have no interest in educating foresters. The States, with their agricultural colleges, have no sufficient facilities. It seems, then, that the General Government should enter upon the work. The Government of the United States, acting for the people, has the greatest interest. In years past it has expended millions in the exploration of this vast domain. It has expended millions in warring with the hostile savages who have roamed over it. It has a second mortgage on the great railroads which traverse it. The Government of the United States, being the greatest land holder, also has a paramount interest in reclaiming this empire and converting it from a wilderness to fields, gardens, orchards, forests, and pastures. That the Government should actually do the work is not to be expected, but it seems to be reasonable to expect that it should aid in doing it. Knowledge is power; and let the Government furnish the knowledge. The Government owns the land; it can set apart any amount of it which may be required; it can place the work in the hands of the best practical talent of the country; it can do on a large scale what individuals are doing on a small scale. As the Government is impersonal and can be accused of no sinister or selfish interest, the statements put forth under the sanction of the Government officers and agents will be received as the truth. It will be shown what trees can and what cannot be grown on the plains; what are the effects of copious and limited irrigation; what is the actual amount of water required for given areas; what is the result of irrigation on the same land for a series of years; and, most important of all, what is the effect of planting large bodies of trees—actual forests.

AMENDMENT OF THE TIMBER-CULTURE ACT.

So far the only legislation by Congress intended directly for the encouragement of practical forestry is what is known as the timber-culture act. It has been several times amended, and needs further amendment. It has been so long in existence that its faults are well known, and there should be no hesitation in remedying the law, that its original purpose should be carried out as far as the intention of any law is attainable.

The law contemplated that when a quarter-section was taken as a timber claim, it should be held as such until the terms of the law had been fully complied with, and a certain number of trees had been added to the forest area of the country. The intention of the act, according to the testimony of Government officers and other competent witnesses, has been avoided; non-residents and speculators have taken claims under the timber-culture act merely for the purpose of selling them to persons who wished to take them as homesteads or pre-emptions. It will be readily seen that this is an absolute avoidance. It works a failure of the object of the act. The remedy for this seems to be the adoption of the principle, "*Once a timber claim, always a timber claim.*" By this is meant that when a filing has been made under the timber-culture act, the land should be withdrawn from entry under either the homestead or pre-emption acts, so that the title shall never be perfected except in compliance with the letter and spirit of the timber-culture act.

The law is defective in allowing trees to be planted as far apart as twelve feet. Young trees need each other's support. Close planting is the law of nature, and nurserymen are more and more coming to recognize it, west of the Missouri at least. Taking the ground that the object of the law is to have the ground covered with live trees and not dead ones, the greatest distance allowed between trees at planting should be four feet. If the trees when growing become too thick they will be trimmed out by nature herself.

TIMBER ON HOMESTEADS.

The power of the Government over public lands is absolute. It can, in conveying them, impose any regulation not in hostility to the "general plan of granting the public domain to actual settlers under reasonable conditions." In addition to the actual occupancy for five years now required, the homesteader might with profit to himself and advantage to the country be required to plant and maintain during the five years one acre in forest trees, or set a row of trees along the highway, or both.

WHAT STATES MAY DO.

Except in Texas, where the State owns all the public land, the States own nothing but the school lands and lands granted for educational purposes. The power of the States over them is absolute, and in their sale the condition might be imposed on the purchaser that a certain portion of the land shall be kept in forest. The legislatures of the several States may take action making it obligatory on school directors to maintain trees on school-house grounds, and also making it compulsory on land owners to keep trees growing along the country roads.

DUTY OF RAILROAD COMPANIES.

The duty and the interest of the great land-grant railroad corporations lie in the direction of the encouragement of forestry. Next to the General Government, these companies are the greatest land owners on this continent. They have received from the Government and municipalities, from the people, in short, an imperial gift, the source of immeasurable wealth, and this has been given them almost without conditions. It is but just that they should in return do everything possible toward the improvement of the country their lines traverse; and it is also their interest to do so, since whatever increases the productiveness of the country increases their own business. These corporations, with their great and hourly increasing wealth, can do what individuals cannot do, and on them devolves the inauguration of the plan of planting great forests—not little experimental gardens, not a few trees in the depot grounds, but tracts such as are found in Europe of tens of thousands of acres. It is estimated that every year 275,000 acres are stripped in this country to furnish railroad ties, and the process of restoration must keep pace with that of destruction, else the time will come when railroad ties cannot be secured at any figure. Why should not a great railroad company, with millions of acres at its disposal, raise its own railroad ties? We have spoken elsewhere of the very praiseworthy experiments of the railroad companies in the direction of tree-planting. But the experience of tens of

thousands of practical men, farmers and others, has shown that as far as Minnesota, Iowa, Kansas, and Nebraska are concerned, the era of experiment has passed. It is, for instance, as well known now as it ever will be, that the catalpa, the black walnut, the Osage orange will thrive, and that they may be profitably cultivated. Instead, therefore, of continuing the discussion of a settled question, the railroad corporations should set out trees; not by the hundreds of acres, but by the thousands. This is a case where timidity, conservatism, and niggardliness mean loss. There are many ways, too, in which railroad corporations may foster the forest interests, as the distribution of forest-tree seedlings, nuts, and seeds. A private firm, R. Douglas & Son, of Waukegan, have sent out millions of trees in packages by mail. A great railroad company could do this on an even greater scale with the prospect of a sure return. In a few years they would not be obliged to seek remote and almost inaccessible mountains for ties, but would have them growing within sight of their own tracks for hundreds of miles. We do not doubt that the facts here set down will be recognized as the truth sometime, but every day of delay is a day of loss. But after the National Government has done what it may, after State governments have done what lies in their power, the question of reforesting and of supplying with forest the region now destitute depends upon the people, and their action depends on an affirmative answer to the question, "Does it pay?"

LET US PLANT FOR OURSELVES.

We have, in a previous chapter, demonstrated that the planting of forest trees *does* pay; but the evidence which can be given within the limits of a report like this is but a drop in the ocean of procurable testimony. From the sandy plains of Cape Cod, swept by the bitter winds of ocean, where pine plantations have successfully been cultivated, to the sage-brush plains of Colorado, the answer is the same, that trees as a crop are profitable, paying as surely as corn or the other cereals. Those who have not made the subject a study have no conception of the amount of printed matter that has been and still is constantly accumulating on this subject; the observations of individuals, the reports of committees, the transactions of societies, cover hundreds of thousands of pages, and in them all there is not the evidence of a single human being to the effect that he had lost time or money in planting trees. Much sentimental talk has been indulged in concerning our duty to the next generation. We should plant trees, it is said, under which our grandchildren may repose. This is doubtless a fine and ennobling sentiment, but the average American citizen cares little for the generation preceding him, and nothing for the generation to come; he expects the next generation to provide its own shade. The question he wishes to determine is whether the trees he plants will benefit men in this generation. Curiously, people almost always overestimate the age of trees. Who has not heard a great elm or oak spoken of as centuries old when it really has grown within the lifetime of living men? Trees are a sure crop, and, after all, a quick crop. The homesteader who goes out on the raw prairie knows that it is five years before his farm can be producing crops with anything like regularity. His trees are making a return as soon as his fields are. The Mennonite settlers in Kansas, of whose success we have spoken, in seven years, at the farthest, from the time they turned the first sod, are literally sitting in the shade of the trees they planted; are raising their own firewood, and eating the fruit of their own mulberry trees. What these settlers from Russia, strangers to our climate and soil, can do, others can do. It must be remembered, too, that the objectors have had their day; every argument which can be used against the cultivation of forest trees has been used in the prairie States west of the Mississippi against the cultivation of fruit trees. For example, men accustomed to hillside orchards in the old States have demonstrated to their own satisfaction that apples would not grow in Kansas; but wagons full of round and rosy evidences to the contrary may be seen standing in the streets of every Kansas market town. The number of those who till the soil, be it a bit of garden ground or acres by the hundred, who believe in the profitableness of trees, is constantly increasing. In front of the humblest cottage in town you see the three or four maples or elms covering the front of the lot; and out on the wide prairies, as far as settlement has extended, the group of planted trees marks the outpost of the picket guard of civilization. It is with the hope of contributing in some way to this useful and beautiful pursuit, which is to shelter the bare and blistered earth; which is to catch and hold the rain and the dew; which is to shelter the home and its occupants from summer's heat and winter's cold; which is to bring fuel and comfort to the housewife; and which is to increase by millions the well-earned wealth of a nation, that this brief report is submitted to reading and thinking people.

TREE PLANTING AND GROWING ON THE PLAINS.

By Robert W. Furnas, *of Nebraska.*

This paper is intended only as a brief presentation of experiences and results concerning tree-culture and tree-growing on the Western plains, made by and coming under immediate observation of the writer during a residence of twenty-seven years west of the Missouri River, in the Territory and State of Nebraska, the principal object being to show what has been done practically, is being and may be done, converting a naturally timberless portion of country into a tree-growing region. Taking the geography of boyhood days, together with official reports of Captain Miles, United States Army, and the western explorer, Colonel Fremont, relating to that portion of the national domain situate between the Missouri River and the Rocky Mountains, as a basis for conclusions, there was at date of extinguishment of Indian title to these lands in 1854 nothing enticing to enterprising adventurers seeking new homes in the far West, especially in matters of tree-growing. The thought that the then naked plains would ever be transformed into groves of valuable timber was not entertained. Those who first came, during the years 1854-'55-'56, soon discovered, however, that, particularly along the borders of streams and where prairie fires were kept out, there was promising spontaneous indigenous growth of valuable varieties of timber—oaks, black walnut, hickories, elms, ashes, red mulberry, honey locust, hackberry, linden, soft maple, sycamore, Kentucky coffee tree, red cedar, cottonwoods, willows, and others. Still later it was found by experiment that native seedlings transplanted into carefully prepared soil did well on high uplands—out on the open prairie not only did well, but grew with remarkable vigor and rapidity, showing characteristics of excellence in quality. To those of indigenous growth were added in time varieties of foreign origin—hard or sugar maple, American chestnut, white walnut, poplar, beech, birch, black locust, larch, pines, catalpa, black cherry, and others. While success followed efforts in this direction, only the most sanguine adventurous experimenters had faith in ultimate practical results. In time, through an act of the Territorial legislature, creating a board of agriculture, the labors of the board organized under its provisions, and afterwards legislative appropriations, keeping out annual fires, and other aids and precautions, tree-growing in Nebraska is universally conceded a success. There is now no hesitancy or risk in predicting in the near future that it will be known and characterized as a timber-producing region of country.

EXTENT OF TREE PLANTING AND GROWING.

But little tree-planting was done in Nebraska, and by reason of annual fires sweeping very generally over the country spontaneous growth was exceedingly meager, for at least ten years after organization of the Territory, and first efforts by settlers to improve and develop. To cover all the ground and afford a more satisfactory presentation of the subject-matter under consideration, commencement is made with date of passage of Kansas-Nebraska act, 1854. From that time up to and including the year 1882, covering a period of twenty-eight years, official statistics, with some reliable estimates to cover dates not thus provided, it is found there has been planted within the borders of what is now the State of Nebraska 244,356 acres of forest trees. This includes seedlings, seeds, and cuttings planted in permanent forests, groves, and along highways and streets in cities and villages. Spontaneous indigenous growth, since fires have been kept from borders of streams and ravines, is estimated equal to half the area planted.

Personal observation would warrant a larger proportion. Not a few informants contend for an equal extent; some higher, even to double. James T. Allan, Omaha, ex-secretary American Forestry Association, now in employ of the Union Pacific Railroad Company, traveling extensively over the State, responding to inquiries on this particular point, writes: "I have watched the spontaneous growth of young elms, walnuts, oaks, ash, hickories, &c., along the Missouri, Wood, and other rivers in the West, since fires have been kept back, and seen their growth among the hazel brush, which is the fringe on the border of native timber, dividing it from the prairie. I hardly think I am out of the way in setting it at double the amount of timber planted."

A majority, however, in various parts of the State, place the estimate as stated—at one-half.

It is safe to say a majority of planting is made, originally, four feet by four, with view to cutting out first one-half, as growth demands space, and eventually another half of that remaining—three-fourths in all. Some plant six by six, others eight by eight. Planted four by four we have 2,622 trees to the acre, or a total of 640,701,432; eight by eight, 682 to the acre, or a total of 166,680,792. Average the totals, and there is shown 403,676,112. Add to the average the spontaneous estimate, one-half, and th grand total is, planted and grown in 28 years, 605,514,168 trees.

The number of trees per acre, spontaneous grow th, will more than equal one-

the acreage planted. It is estimated one-fourth of the trees, seeds, and cuttings planted did not grow, and therefore not now occupying the ground. Spontaneous growth, except where the weak have been crowded out by the strong, and such as may have been destroyed by occasional fires, it may be said all are growing.

DEMONSTRATED USEFUL AND VALUABLE VARIETIES.

It has been practically demonstrated that the following valuable varieties of forest timber can be successfully and satisfactorily grown—both planted and of spontaneous growth. Only the most valuable are named in this list. Those designated with a * are indigenous.

Ash:
*Fraxinus Americana.**
*viridis.**
*quadrangulata.**
*pubescens.**
*platycarpa.**
*sambucifolia.**

Oak:
*Quercus alba.**
*obtusiloba.**
*macrocarpa.**
*prinus.**
*tinctoria.**
*rubra.**
*nigra.**

Chinquapin oak—*prinoides*—of shrub character, grows in abundance, particularly on the bluff lands adjacent to the Missouri River, and in places in profusion on prairie lands, many acres in a body. It is a profuse bearer; nuts equal almost to chestnuts. In early days it was considered a "Munchausen" story when old settlers talked of hogs eating acorns from trees. The small growth, often not over a foot high, was loaded with nuts, and therefore easily eaten off by swine. Deer and antelope fatted on them.

Black walnut:
*Juglans nigra.**

White walnut:
Juglans cinerea.

Hickory:
*Carya alba.**
*sulcuta.**
*tomentosa.**
*porcina.**
*amara.**

Elm:
*Ulmus Americana.**
*fulva.**
*racemosa.**
*alata.**

Hackberry:
*Celtis occidentalis.**

Honey locust:
*Gleditschia triacanthus.**
*monosperma.**

Kentucky coffee tree:
*Gymnocladus canadensis.**

Linden:
*Tilia Americana.**

Sycamore:
*Acer pseudo-platanus.**

Black locust:
Robinia pseudacacia.

Soft maple:
*Acer dasycarpum.**

Sugar maple:
Acer saccharinum.

Sugar maple grown thus far little else than for ornamental purposes—lawns and street trees. There is no reason why it may not be grown successfully for forest purposes, as it thrives well when introduced and planted.

Poplar:
Liriodendron tulipifera.
Wild black cherry:
Prunus serotina.
Wild red cherry:
*Prunus Pennsylvanica.**
Catalpa, hardy:
Catalpa speciosa.
Cottonwood:
*Populus monilifera.**
*heterophylla.**
Willow:
*Salix purpurea.**
*cordata.**
*longifolia.**
*nigra.**

Valuable characteristics are noted of a willow growing spontaneous along the Missouri River from the mouth of the Big Nemaha, south, to the Yellowstone, north, familiarly known as "Diamond willow." Professor Sargent names it *Salix cordata*, var. *vestita*. Experience demonstrates it as durable for underground uses—posts—as red cedar.

Box-elder:
*Negundo aceroides.**
Chestnut:
Castanea Americana.
Pine:
Pinus sylvestris.
Austriaca.
strobus.
Red cedar:
Juniperus Virginiana.
Larch:
Larix Europœa.
Americana.
Mulberry:
*Morus rubra.**
alba.
moretti.

Many varieties of less value than the foregoing, embraced in a complete sylva of the State, are here omitted as not of practical value for forest purposes.

GROWTH OF TREES.

The following actual measurement of tree growths, of known ages, are made, showing circumference in inches two feet above ground:

Names of trees.	Years old.	Inches.	Names of trees.	Years old.	Inches.
White elm (*p*)	15	24¾	White ash (*s*)	22	32¼
Red elm (*s*)	24	36	Green ash (*s*)	22	30
Catalpa (*p*)	20	48½	Black walnut (*s*)	22	48
Soft maple (*s*)	18	54¾	Black walnut (*p*)	22	50¼
Soft maple (*p*)	18	69¼	White walnut (*p*)	22	49¼
Sycamore (*p*)	16	43½	Osage orange (*p*)	25	26¼
Pig hickory (*s*)	24	37½	Larch (*p*)	10	24
Shagbark hickory (*s*)	24	30	White pine (*p*)	20	36¼
Cottonwood (*s*)	23	78¼	Scotch pine (*p*)	15	23
Cottonwood (*p*)	23	93	Austrian pine (*p*)	15	22½
Chestnut (*p*)	14	24½	Red cedar (*p*)	15	26¼
Box elder (*s*)	14	25¼	White cedar (*p*)	15	22
Box elder (*p*)	14	31⅛	Mulberry (*p*)	18	43
Honey locust (*s*)	22	40¼	Mulberry (*s*)	18	39¼
Honey locust (*p*)	22	41½	Linden (*s*)	14	35
Kentucky coffee tree (*s*)	14	25½	Poplar (*p*)	4	12
Burr oak (*s*)	22	36⅜	Black locust (*p*)	24	60½
White oak (*s*)	22	29	Red willow (*p*)	20	58
Red oak (*s*)	22	37⅛	Gray willow (*p*)	15	26¼
Black oak (*s*)	22	88½			

s, spontaneous growth. *p*, planted growth.

ORDER OF VALUE.

The order of ultimate value, deciduous varieties, while there may be difference of individual opinion, it is safe to arrange: white, burr, and chestnut oaks; black and white walnut; white, green, and blue ash; black cherry, catalpa, black locust, honey locust, Kentucky coffee tree, elms, hickories, larch, soft maple, hackberry, mulberry, cottonwoods, willow, box elder.

For present or near value, cottonwoods—especially the yellow—are almost universally conceded preferable. There are, as shown, two varieties, yellow and white—*monilifera* and *heterophylla*. The yellow makes excellent lumber, particularly for inside uses, not exposed to weather. For shingles, only pine, cedar, or walnut are superior. Both make good fuel, after reasonable drying or seasoning. Old steamboat and mill men prefer half-seasoned cottonwood to any other obtainable in this region, claiming that they get more steam from it; also much used in burning brick. No other wood holds nails so well.

Red cedar, white, Scotch, and Austrian pines stand in order of value as evergreens, and are usually so planted.

ORDER OF PLANTING.

The order of tree-planting, numerically speaking, of deciduous varieties is, as near as may be, cottonwoods, box elder, soft maple, elms, ashes, black walnut, honey locust, catalpa, oaks, hickories, Kentucky coffee tree, black locust, larch, sycamore, hackberry, mulberry, black cherry, and willows. Two-thirds of the whole are cottonwoods, from the fact they are more easily obtained, cost less, are of more rapid and certain growth, and from which realizations are more speedily and certainly secured, and, in addition, succeed almost anywhere planted.

SPONTANEOUS GROWTHS RANGE IN ORDER OF VALUE.

Oaks: red and black, perhaps, predominating; hickories; more shagbark than others. Black walnut, elms, linden, white ash, mulberry, and hackberry on higher lands; on bottoms, cottonwoods, box elder, willows, sycamore, soft maples, green and water ash.

PRICE OF FOREST-TREE SEEDLINGS.

Prices of forest-tree seedlings are such as to place them within reach of the very poorest; in fact, as the great bulk planted are of spontaneous origin, they are to be had for mere gathering in regions where found. When trafficked in, prices range, owing to variety and size, from six inches to four feet, all along from fifty cents to three dollars per thousand; nursery-grown plants grade higher. Many millions are now planted annually.

ENCOURAGING ENACTMENTS AND PROVISIONS.

The Nebraska State constitution provides that "the increased value of lands by reason of live fences, fruit and forest trees grown and cultivated thereon shall not be taken into consideration in the assessment thereof." A State law "exempts from taxation for five years $100 valuation for each acre of fruit trees planted, and $50 for each acre of forest trees;" also makes it obligatory that "the corporate authorities of cities and villages in the State shall cause shade trees to be planted along the streets thereof."

Further: "Any person who shall injure or destroy the shade tree or trees of another, or permit his or her animals to do the same, shall be liable to a fine of not less than $5 nor more thad $50 for each tree injured or destroyed."

To encourage growing live fences the law permits planting "precisely on the line of the road or highway, and for its protection to occupy, for a term of seven years, six feet of the road or highway."

ARBOR DAY.

This day originated in Nebraska through action of the State Board of Agriculture. It is a day designated by the board during planting season, each spring, usually about the middle of April. The board annually award liberal premiums for the greatest number of trees, cuttings, and seeds permanently planted on that day. The governor annually, by proclamation, recognizes the day for purposes indicated, urging the people to devote it exclusively to tree-planting. It is very generallyobserved, and millions of trees planted that day.

MODES OF PLANTING AND TREATMENT.

The usual distances apart are by multiples 4, 8, 12, 16, &c., that intermediate ground may be utilized by being cultivated in other crops until trees are of sufficient size to protect themselves, when, in farm parlance, they are permitted to "take the ground."

Most experimenters at first planted tree seeds where they were to remain permanently. Experience has shown this a mistake, for numerous reasons. Principally, by this mode, uneven stand, growth, grade, size, and vigor are to contend with. By planting seeds first in beds, and, say at one year's growth, assorting, grading, and transplanting permanently each grade to itself, better results are secured. The same grades as to size and vigor do better together; grow more evenly; the weak are not crowded out or overshadowed by the stronger—a practical illustration of the "survival of the fittest."

By this plan small plants, if healthy, do about as well in the end as the large. No variety is known that cannot be safely transplanted at one year old. Even varieties of tap-root characteristics—oaks, walnuts, hickories, and chestnuts—are really better, I am convinced, for tap-root pruning. By it laterals, or fibrous, feeding roots are induced; or, if larger sizes are desired before transplanting, root pruning, by running a tree-digger under rows and allowing them to remain a year or two longer, good results are obtained. As a rule, however, better success is had by transplanting young trees when, as near as possible, all roots are preserved. Small trees cost less to purchase, transport, handle, and transplant. Alternating, especially certain varieties, has not given satisfaction. Trees in some respects are not unlike mankind—will not fraternize. For instance, oaks, walnuts, and hickories will not fraternize with maple, cottonwoods, and elms. When planted near each other, the latter will invariably lean away from the former, assuming crooked, gnarly appearance, and in the end virtually die out.

INCIDENTAL ILLS.

Thus far few ills have attended timber culture in this State. The great losses or failures have been from careless handling, planting, and after neglect. Black locust was planted extensively in earlier days, but, being so badly affected by borers, its cultivation, until of late, was almost entirely abandoned. The pest which almost universally destroyed it in the beginning, suddenly and without known cause disappeared, and that valuable variety of timber is again receiving merited attention. In certain portions of the State, during one or two years, a large green worm, name not known, defoliated most soft maples, for a time checking their growth. In a few instances the same borer attacking black locust, to a limited extent injured soft maple and cottonwoods. They being of such rampant growth, injury was not material. Trees attacked were principally those used for ornamental purposes—those on streets in cities and villages.

Where ground has been well and deeply prepared, good, healty plants used, care exercised in handling and planting, followed by attention and proper cultivation until able to care for themselves, there has been no good cause for complaint.

IMPORTANCE OF SPONTANEOUS GROWTH.

Too much importance cannot attach to spontaneous timber growing. Nature, in this respect, is both accommodating and bounteous in her provisions. Waste places, as a rule, are utilized. Lands which, if at all adapted to other uses, could only be prepared at extra expense, are those nature occupies and renders of value. This growth comes of its own accord, so to speak, without preparation or labor by man, other than to guard against fires, along broken and often precipitous bluffs and ravines, in nook and corners of tortuous and meandering streams incident to prairie regions. A belief is freely expressed that greater proportionate successful tree-growing, and at comparatively no expense, has been done by nature than by planting. As stated before, by a far greater proportion of such planting and growing stands and succeeds than that of artificial processes. Losses are rare, and only from occasional invading fires, and, where too thick on the ground, the stronger kill out the weaker—no loss in fact—simply adjusting or equalizing. Personal knowledge is had of many instances where lands, twenty and twenty-five years ago, considered worthless, are now valued at from twenty to one hundred dollars per acre, solely for the timber naturally grown.

ROBERT W. FURNAS.

BROWNVILLE, NEBR., *December* 1, 1882.

The PRESIDENT. The paper which Mr. Baker has just read is one which will go into a special report and be very much enlarged by him.

I presume there is no desire to discuss the paper, and if not, I will state that the first paper to be read on Monday morning at 10 o'clock will be that of Professor Page upon "Improving the worn-out lands comprised in the area known as the Southern Atlantic slope."

Mr. FORD. Allow me to inquire if the subject of fruit culture will come up at any time during this Convention?

The PRESIDENT. That is not included in the list, as it was fully discussed last year, but if there is any paper to be furnished I shall be very glad indeed to assign it a place.

Mr. FORD. I represent the Potomac Fruit-Growers' Association, and they asked me to prepare a paper on that subject.

The PRESIDENT. I shall be very glad to have it.

Mr. PAGE, of Virginia. I move we now adjourn.

The motion was agreed to, and at 4 o'clock and 5 minutes the Convention adjourned until Monday morning at 10 o'clock.

SIXTH DAY.

MONDAY MORNING, *January* 29, 1883.

The Convention met at 10.20 a. m.

The President introduced Mr. Wheelwright, of New York, who explained the objects and needs of the Holland International Exhibition, after which the following preambles and resolution were unanimously adopted:

Whereas our Government has been invited to participate in the International Exhibition to be held in Amsterdam, Holland, from May 1 to October 31, 1883, under the auspices of H. M. the King of the Netherlands; and,

Whereas no provision has yet been made by Congress to enable our citizens to make a creditable exhibit of our industries: Therefore,

Resolved, That this Convention earnestly recommend our agriculturists, railroad companies, land owners and others, to avail of so favorable an opportunity as this exhibition presents to call the attention of European capitalists and emigrants to the varied resources of this country.

Mr. Gaines was then called to the chair, and Professor Page read the following paper:

THE IMPROVEMENT OF WORN-OUT LANDS.

By Prof. JOHN R. PAGE, M. D., *of the University of Virginia.*

Mr. President and gentlemen, my subject is a very important one—the improvement of worn-out lands in the area known as the Southern Atlantic slope, and to explain briefly the cause of their exhaustion, and the best method of restoring them to fertility for the production of cereals, grasses, cotton, and tobacco. The term "worn out" is used to apply to all lands worked down below the point of remuneration, and we have a large portion of land in this condition. It behooves us to consider how *the average farmer* can improve lands of this class by the readiest and least expensive methods. I would scarcely venture to speak in this presence of the importance of this work were it not that it extends to the inter est of the farmer of the fewest as well as the largest number of acres.

The importance of the subject rests in the fact that American agriculture has been and is now the most ruthlessly exhaustive to the soil ever practiced in any country; that our population has been moving steadily westward from the settlement of the country, passing over one, two and three degrees of longitude in a decade, until it rests at the base of the Rocky Mountains, and that this moving host, with Anglo-Saxon greed, has robbed the soil of its fertility to a large extent wherever it has sojourned.

The importance of the subject is further enhanced by the facts lately reported by the public lands commission to Congress; that the amount of arable lands still remaining subject to occupation under the homestead and pre-emption acts, is barely

sufficient to meet the demands of settlers for a year or two to come; that the total area of settlement in 1880 was estimated at 1,569,570 square miles, being more than half the area of the country, including Alaska, and that the total population being 50,155,783, makes the average population in the cultivatable settled area about 32 to the square mile. If this be true, and it be true also that the population of the country doubles itself every twenty-five years, it must be admitted that the time is not far distant when the population to the square mile will be a troublesome factor, unless timely precautions are taken to restore the fertility and increase the productive capacity of the soil, or the human race be endowed with superhuman power to extract food from it. It follows that the system of cultivating lands to exhaustion and of going to the West to purchase cheaper virgin lands with rich soil must be abandoned. In short, "the breaking down" system as applied to the soil must be given up, and "a building up process" adopted in its place. This restless and impatient spirit towards mother earth and native soil must be subordinated by a calmer and more rational judgment—a judgment which takes into consideration all the facts involved in their treatment and cultivation.

This exhaustive feature of American agriculture has not failed to attract the attention of enlightened European agriculturists and political economists, who have characterized it "*derisively*" as the "American system," and have foretold the evil consequences which must follow such a system in the not far distant future. Of the many causes that have fostered this system, the tenure of land has been the most potent; the excellent laws for the registration of titles and the transfer of real property in all the States; the lavish policy of the Government in regard to the public lands, and the great eagerness of the people to buy or to sell—to go West or to go South—as a chance of profit might appear. These, with other causes too numerous to mention, have brought about the conditions now under consideration. * * *

It is estimated, approximately, that the cultivated land in the United States consists of about three millions eight hundred thousand farms—60 or 70 per cent. of which are cultivated by the owners—representing also a mingling of large, medium and small properties, in which those of medium size predominate. While the characters of the men who are the cultivators of these farms are different in different sections, they are all more or less alike animated by the same spirit, viz, to make all that is possible out of the land culivated, and then to sell it and purchase other richer and cheaper lands farther west or south.

Since 1870 the number of farms in the thirteen States that held slaves has increased 65 per cent.—a condition which Mr. Edward Atkinson thinks has been highly favorable to the production of cotton, and is equally favorable to a system of "mixed farming."

It will be admitted that in the face of this breaking-down system in the old States, there are many sections in which honest efforts have been made to repair the waste and to bring out the capabilities of the soil and climate, but better plans are required and greater efforts at improvement will be necessary to meet the demands of the future.

It is evident that the tide of population, which has flowed so steadily and rapidly from the exhausted to the fertile soils farther west, must soon turn in other directions, or return gradually to the Atlantic slope from which it started. But as there is a period between tides, known as "*slackwater*," so it may be with this tidal wave of population. It may remain for a time near the base of the Rocky Mountains, whose elevated and arid plains may be made productive by irrigation, or it may turn in the direction of New Mexico; still the reflux to the Atlantic slope is inevitable sooner or later.

Again, if this breaking down system is continued, the result must be a great falling off in the productions of the whole country, a diminution of exports, and a large increase in values of all kinds. To meet these conditions, which past experience and reasonable forethought admonish us must occur, is the problem which should occupy the minds of all the people of the old States. "To be forewarned is to be forearmed." Some well-defined and systematic processes of "building up" the soil in farming must be speedily adopted and urged upon the people, to prevent the continued exhaustion of the soils of the old States, and to balance the waning fertility of the new; and there is no medium through which this can be effected so well as by the United States Department of Agriculture; it is for this reason I trespass upon your time to-day.

In natural adaptations of soil and climate, no region in the world is better suited to sustain a larger population to the square mile, than that comprised within the limits of the Southern Atlantic slope; no region is so well adapted to the growth of the great staples; none better adapted to "*mixed farming*," and few better adapted to stock-raising, wine-making and fruit culture, and none possessing such great natural resources of fertility. While the lands generally have been worked down below the point of remunerative cultivation, they possess good soils, and it may be taken as an *axiom* "that soils originally good can never be absolutely exhausted, and rapidly recover under ameliorating agencies." The incessant oxydation and breaking

down of the elements of the soil, during the continuous cultivation of crops in the old States, have been definitely proportioned to the amount of the products taken from them during the many years they have been cultivated. Witness the alluvial lands in the tidewater, and the lands in the granitic sections of Virginia, Maryland and North Carolina, from which have been taken in the course of two hundred years such immense quantities of tobacco. This and other products have gone to build up and enrich the soils of the countries in which they have been consumed, at the expense of the land in which they were raised. It is evident that unless some regular process of repair, or return of the elements taken off in these products, shall have been made, the soils must necessarily have been exhausted below the point of remunerative cultivation, and such we find is generally the case. But it is a fact worthy of mention that many of these lands have great natural powers of recuperation—that if left out of cultivation for a few years they improve rapidly, an improvement due to the incessant oxydation of the minerals in the soil and the natural growth and decay of vegetable matter; still the fertility thus induced is far from being equal to restore the lost balance. Other and more potent ameliorating agencies are required to bring out fully the capabilities of the soil and the climate in their adaptation to the cultivation of any single crop or order of crops. While it is not a difficult matter to make a rough canvass of the capabilities of the lands of any district, their restoration to fertility is a very different affair, and demands careful and elaborate observation. To perform this work satisfactorily while cultivating an order of crops, requires mental enterprise, a natural fondness for farming, and a ready apprehension combined with persistence and a sound judgment. This a large majority of farmers does not possess. In Europe the knowledge of soils and of the climate on which the cultivation of the land is based and the ameliorating systems of improvement in use, are the result of the accumulated experience of hundreds of years. An orderly succession of all the plants cultivated and of the manures best adapted for the highest productions of each is recognized as absolutely necessary to make a fair return to the soil for the crop taken off, and to prevent its deterioration. In this country our farmers work without system, plan or pattern. But any rational system of improvement of worn-out lands on a large scale, should rest upon a surer foundation than mere tradition or superficial rules. Scientific principles are involved at every step, and they must be continually borne in mind and put into practice, to insure the speediest and best results.

To summarize briefly the principles involved, the cultivation of crops withdraws from the soil immense quantities of substances, so that sooner or later the moment must arrive when the produce will diminish and at length altogether cease, unless those constituents of the soil which the crops have withdrawn from it be replaced. The object of the farmer must, therefore, be so to work his ground that the soil never becomes exhausted, but that he shall constantly obtain abundant crops, *and adequate interest on his capital—the soil.* There are two modes of securing this: by a carefully selected succession of different crops and by manures. He must, of course in addition, depend on a suitable mechanical working, loosening and draining of the ground. In consequence, the *selective power of plants*, for example, a succession of a number of crops of an alkaline plant, causes the soil to become for a time and at length, when all the alkalies have been consumed, permanently unproductive for plants of this description. But while the alkaline plant has the power of withdrawing an unusual proportion of alkalies from the soil, it leaves all the other nutrient substances comparatively untouched. These substances, therefore, accumulate in the soil, the small consumption of them being outweighed by the decomposing influence of the atmosphere, which is constantly reducing to a soluble condition small quantities of soil, and thus rendering their constituents available for nutrition. The substances which are thus made available for the plant are retained by fertile soils, and thus their solution by rain, &c., ensured for at least a sufficient time, for the whole of the soil to become saturated by them. It is therefore essential to good agriculture that the crops of the alkaline plant should be followed by one of another kind, say a siliceous plant; and thus a well-chosen succession of different crops will remove from the soil one substance after another. This order or rotation must be continued until the substances first withdrawn are restored in such proportion and distribution that the same series of crops may again be grown. In former times the influence of the atmosphere on the soil was utilized by cultivating only a portion of the soil, the rest being left untilled or fallow; but it is now acknowledged that this mode of agriculture is not economical. In those districts where it pays to cultivate large tracts of land, no considerable portion is now left fallow; but the object is, by a good rotation of crops, to use up as equally as possible all the constituents of the soil. Even under the best system of agriculture, however, the soil must become gradually exhausted and this exhaustion must be artificially counteracted. This purpose is effected by a scientific system of manuring, by which those substances are supplied to the soil of which it has most need. According to circumstances, the most various organic and inorganic substances may be employed as manures. And these manurial substances must con-

tain in assimilable form and reasonable amount the plant-food elements known as nitrogen, phosphoric acid and potash. These are the main principles on which the improvement and successful cultivation of worn-out lands are based. But a few words of caution just here may not be out of place. It is a great mistake to suppose that all of our lands were originally fertile, and that all can be improved by similar methods. There are certain areas of land on every large plantation exhausted of the elements of plant-food, the cost of improvement of which would far exceed the remuneration to be obtained. It would have been better if such lands had never been cleared; and it would be better even now to let them grow up in pines than to attempt to improve them with the limited amount of capital at our disposal. Lands naturally and originally poor cannot be made highly productive, except at a considerable cost by artificial means. Every soil has an inherent capacity for production called "*natural strength*," which is chiefly due to its power of supplying the elements of plant-food. Before undertaking to improve worn-out lands, therefore, it will be well to ascertain as far as possible the natural strength, or the original fertility. This may be best accomplished by examining into, 1st, the nature of the bed-rock; 2d, the character and formation of the soil; 3d, the growth of plants; and 4th, the exposure and drainage.

The importance of carefully considering these points is, (1) that all rocks are composed of mineral elements, the disintegration of which gives more or less fertility to the soil; (2) that soils are nothing more than small particles of decomposed rocks mixed with organic matters derived from the decay of vegetable and animal substances; (3) that there is an intimate connection between the kind of soil and the plants which grow naturally on it; (4) that natural or artificial drainage is the "*sine qua non*" of production in any soil. Their importance, therefore, cannot be overestimated. From what has been said it might be inferred that no orderly system of improving worn-out lands in this country has ever been persistently practiced. In certain portions of the older States, where the soils have been worked down and exhausted by continuous cropping in tobacco, corn and wheat, from the early colonial period, the necessity of doing something to increase the products and prevent the waning fertility of the soil was met only by turning the land out to rest, and to recover "*per vias naturalis.*" Naturally too, this necessity became more urgent from year to year, and other methods of amelioration had to be adopted. It may not be uninteresting or uninstructive to review the most important of these methods, to give the views of some of the most prominent men who advocated them, and to show how they bear upon the questions of the day.

METHODS BY WHICH THE MOST APPROVED SYSTEMS OF AGRICULTURAL IMPROVEMENT HAVE BEEN EVOLVED.

A distinguished man, at the close of the last century (1798), says:

"The original settlers first cleared a corn-field in the forest, next a tobacco lot, and cultivated both with successive crops of the same articles until their powers of production being completely exhausted, resort was again had to the forest, and a new corn-field and a new tobacco lot were cleared. The same process was repeated until almost the whole of the highly-favored region of tide-water in Maryland, Virginia, and North Carolina was despoiled of its fertility. Bad cultivation with the plow, up and down hill, came in aid of this destruction by fire and ax. Whenever fertility was by these methods destroyed, the fields were thrown out of cultivation; stunted pine and broom-straw uniformly succeeded to the occupation of the land originally occupied by the finest oak, hickory and poplar; and wherever a few of the latter escaped destruction, they serve beside their dwarfish neighbors, as monuments of the munificent bounty of God, in melancholy contrast with the thoughtless improvidence of man. It is true, there are scattered in different parts enterprising, intelligent and spirited individuals whose husbandry does them great credit. But though the improvements which they have made have doubled the produce and value of their lands, and their efforts have been crowned with the most distinguished success, *their example has had but little effect in reforming the habits of the country in general.* These habits finally reduce those who indulge in them to poverty, and banish them from their homes."

While this gloomy picture is but too faithful a representation of this interesting portion of our country, where the choicest advantages for successful agriculture have been bountifully showered by a beneficent Providence, it is interesting to notice that *true methods* of agriculture were still preserved by a faithful few in the land.

The first step in the direction of improvement seems to have been the adoption of a system of rotation of crops and a division of the cleared land into three fields, called "*shifts*," one of which was cultivated in corn and tobacco, one in wheat and oats or barley, and one was pasture, with as many cattle as would graze double the land allotted.

About this time the cast-iron mold board and the hillside plow were brought into use, the latter being the invention of the Hon. Thomas Mann Randolph, governor

of Virginia. The valuable properties of gypsum and lime, with the use of clover, were also recognized, and the advantages of using them was no longer considered doubtful. Under the "three-shift system" all the manure was put on the tobacco land; wheat and barley followed the tobacco and corn. Clover-seed with plaster was often sowed on the wheat land; but the wheat stubble being pastured by the stock soon after harvest, the clover was too speedily consumed to do the land any good. We are told that while with better cultivation this system was followed by better crops, the land steadily grew worse. To prevent this, an increase in the number of "shifts" was thought to be the best remedy, and this led to the adoption of the celebrated "Fairfield system" of Norfolk, England, with high hopes of success, because it was highly extolled by all the agricultural writers at the time as *the system* by which the immense estates of Mr. Coke had been brought to such high state of fertility. The four-course rotation pursued at Holkham was first, turnips manured, and afterwards fed to stock; second, wheat and clover seed; third, clover; and fourth, barley manured and fed also to stock; in which two green crops and two manurings were given to the soil during the course, the wheat crop and the stock being sold off. The maxim was, "No dung, no turnips, no bullocks, no barley, no clover, nor teather the second year's lay for wheat;" a practical way of securing nitrogen, phosphoric acid, and potash. But alas! how different was the system carried out in this country, where but little manure and no green crop was given to the soil. It appears it was not until after the war of 1812 that it was discovered that it was not so much *the system as it was the succession of crops and the special preparation for each crop in which the excellence lay.* Another important fact seems also to have been overlooked, viz, the use of *marl and lime,* which was a preliminary to all the operations on the lands of Mr. Coke.

Marshall, in his Rural Economy of Norfolk, says: "The grand fossil manure of Norfolk is *marl,* through whose fertilizing quality, judiciously applied, lands which seem by nature to have been intended as a scanty maintenance for sheep and rabbits, are rendered capable of fattening bullocks of the largest size and of finishing them in the highest manner."

It was surely great wisdom on the part of our tide-water ancestors to have adopted the agricultural system most in vogue in the kindred alluvial formations of Norfolk, in the easternmost part of England.

Marshall says of the soils there: "A singular uniformity of soil prevails throughout this country; there is not perhaps an acre in it which does not come under the idea of a *sandy loam.*" A better general description of the soils of the tide water region of the Atlantic slope could scarcely be given than this.

Marshall also describes the two marls most in use in Norfolk, viz, "a whitish-colored chalk marl," used in the central and northern parts of the district, and "a gray-colored clay marl," used most on the eastern coast. In the tide-water sections of the South Atlantic States we have also two different kinds of marl, easily obtainable, both mines of agricultural wealth, viz, eocene marl and miocene marl, of the especial virtues of each of which I will speak farther on.

During the period of which I am now speaking, between 1804 and 1819, the foremost statesmen of the time put themselves in the forefront for the advancement of agriculture. The genius of Thomas Jefferson, the practical wisdom and forethought of Madison, of De Witt Clinton, of Timothy Pickering, of Josiah Quincy, of John Taylor of Carolina and a number of others, seemed to have been fully exercised in propagating the best methods of agriculture. But it was chiefly through the instrumentality of agricultural societies then organized, that these distinguished individuals put themselves in direct communication with the common farmers of the country by correspondence in writing, as well as on the hustings. Among these correspondences is quite a noted one between Timothy Pickering, of the Essex Agricultural Society of Massachusetts, and Thomas Jefferson, of the Albemarle Society of Virginia, on the use of mangel-wurzel, rutabaga turnips, and making Parmesan cheese; another between Jefferson and Josiah Quincy, on the uses of the lupinella or Italian clover; and others by Jefferson on horizontal plowing, on the best form of plow mold-boards and the best agricultural works for a farmer's library. Agricultural societies were organized in Massachusetts, Virginia, Maryland and South Carolina, with such men as Timothy Pickering and Josiah Quincy as leading members. (See Timothy Pickering's comparative estimate of the value of potatoes, mangel-wurzel, and rutabaga as food for stock, page 357 American Farmer, Vol. I, 1821; Address delivered before the Massachusetts Agricultural Society, by Josiah Quincy, at Brighton, October 12, 1819, page 377 American Farmer, Vol. I; Mr. Madison's address on assuming the presidency of the Albemarle Agricultural Society in 1819, pages 161–177 American Farmer, Vol. I, 1821; Addresses of Hon. R. Smith, Virgil Maxey, and Joseph E. Muse, of the Maryland Society, same date; and General Davis's address before the South Carolina Society, in the same volume, 1821.) It seems impossible that these men should have written so well on such subjects without understanding them, and I believe they did understand them thoroughly; but it was as hard then as it is now to satisfy the mind of the average farmer that any "outsider" can teach him anything about his own land.

Mr. Madison, in the address delivered before the Agricultural Society of Albemarle in 1819, already alluded to, said:

"But whilst all are sensible that agriculture is the basis of population and prosperity, it cannot be denied that the study and practice of its true principles have hitherto been too generally neglected in the United States, and that this State has at least its full share in the blame. Now only, for the first time, notwithstanding several meritorious examples of earlier date, a general attention seems to be awakened to the necessity of a reform.

"Patriotic societies, the best agents for effecting it, are pursuing the objects with animation and intelligence, which characterize the efforts of a self-governed people, whatever be the objects to which they may be directed."

He then points out in a masterly manner "the most prevalent *errors* in our husbandry:"

"1st. The error of cultivating large areas of land, either naturally poor or impoverished by cultivation," summing up in these words: "Any system, or want of system, which tends to make a rich farm poor, or does not tend to make a poor farm rich, cannot be good for the owner, whatever it may be for the tenant or superintendent.

"2d. The error of pressing too hard on the land by the bad mode of plowing it.

"3d. The error of neglecting manures, which may be traced to the same cause with excessive cropping. Nothing is more certain than that continual cropping without manure deprives the soil of its fertility. It is equally certain that fertility may be preserved, or restored, by giving to the earth animal or vegetable manure equivalent to the matter taken from it; *and that a perpetual fertility is not, in itself, incompatible with an uninterrupted succession of crops.*

"Some farmers of distinction, headed by Jethro Tull, supposed that mere earth in a pulverized state was sufficient, without manure, for the growth of plants, and consequently that continued pulverization would render the soil perpetually productive; a theory which never would have occurred to a planter of tobacco or Indian corn, who finds the soil annually producing less and less under a constantly pulverizing course. That individual farms do lose their fertility in proportion as crops are taken from them and returns of manure neglected is a fact not likely to be questioned. If it were, Virginia, unfortunately, is but too capable of furnishing the proofs."

The sum of these remarks on cultivating poor land and neglecting the means of keeping or making land rich is "that if everything grown on a soil is carried from it, it must become unproductive; that if everything grown on it be directly or indirectly restored to it, it would not cease to be productive, and consequently that according to the degree in which the one or the other practice takes place a farm must be impoverished or be permanently productive and profitable. Every acre made by an improved management to produce as much as two acres is, in fact, the addition of a new acre, with the great advantage of contracting the space to be cultivated."

These are the wise opinions of James Madison, the patriot, the statesman and Virginia farmer, in 1819; and they contain a volume of instructions equally as applicable to the present as to the generation to which they were addressed, and upon whose ears they fell unheeded as the passing breeze.

To the English agriculturist, who desires to find out how the different systems of improvement have been evolved in that country, the voluminous pages of Arthur Young, of Marshall, of Tuke, of Sir John Sinclair, of London, and Caird are open, besides the recorded transactions of the Royal English, Scottish and Irish Societies; but in this country we can only look to the scattered records in a few public prints and two or three agricultural journals for any information whatever. Among the latter, the files of the American Farmer, published in Baltimore in 1818–'19, and the Farmer's Register, published in Richmond, Va., furnish original essays and selections on rural economy and improvements of rare value, and in many respects as applicable now as they were at the time they were written. To the American agriculturist the pages of "Arator," by John Taylor, of Caroline, president of the Agricultural Society of Virginia (the fourth and last edition of which was published in 1818), furnish the most valuable information. "Arator" comprises a series of agricultural essays, practical and political, in sixty-four numbers, which might be studied now by farmers and students of our agricultural colleges with the greatest benefit, for in them we find the two plans of furnishing nitrogen to soils. While the author modestly confesses that his chief knowledge as to modes of agriculture is confined to the States of Maryland, Virginia and North Carolina, the principles and practices announced will apply to the whole Union. He says he was aroused to the necessity of making agriculture a subject of special study by reading a pamphlet upon the agriculture of the United States by Mr. Strickland, an Englishman, published in London in 1801, being the result of his own observations during a considerable period spent in traveling through the country for the special purpose of investigating it. The judgment of this impartial stranger appears in the following quotations:

He says: "Land in America affords little pleasure or profit, and appears in a prog-

ress of continually affording less." "Virginia is in rapid decline; land in New York formerly producing twenty bushels to the acre now produces ten." "Little profit can be found in the present mode of agriculture of this country; and I apprehend it to be a fact that it affords a bare subsistence." "Virginia is the southern limit of my inquiries, because agriculture had there already arrived to its lowest state of degradation. The land owners in this State are, with few exceptions, in low circumstances; the inferior rank of them wretched in the extreme. Decline has pervaded all the States." The patriotic author of "Arator" then says: "These conclusions, if true, are awfully threatening to the liberty and prosperity of a country whose hostage for both is agriculture. An order of men earning a bare subsistence, in low circumstances, and whose inferior rank is wretched in the extreme, cannot possibly constitute a moral force adequate to either object. It is therefore highly important to the agricultural class to ascertain whether it is true that agriculture is in a decline. A decline terminates, like every other progress, at the end of its tendency. Upon reading the opinion of this disinterested foreigner, my impressions were indignation, alarm, conviction, inspired successively by a love for my country, a fear for its welfare, and a recollection of facts.

"The terrible facts that the strongest chord which vibrates in the heart of man cannot tie over people to the natal spot, that they view it with horror, and flee from it to new climes with joy, determine our agricultural progress to be a progress of emigration and not of improvement, and leads to an ultimate recoil from this exhausted resource to an exhausted country."

The sentiments contained in these patriotic and eloquent words are as true and as applicable to our condition to-day as they were at the time they were uttered. The systems pursued to-day, as surely as then, lead to an ultimate recoil from exhausted resources to an exhausted country. Being thoroughly aroused, the patriotic John Taylor brought all the powers of his strong intellect to bear upon the study of the principles and practice of agriculture, and thereby rendered great benefit to his State and country.

With prescience recognizing the fact that "the most effectual mode of fertilizing land is found in mineral and vegetable or atmospheric manures; that the two last are resolvable into one; that the earth swims in the atmosphere and inhales its refreshments; that the vegetable world covers the earth, and is the visible agent to which its surface is indebted for fertility; that the vast ocean of the atmosphere is the treasury of vegetable food, and that vegetable manure is obviously inexhaustible; that the vegetable world takes its stand upon our earth to extract the riches of this treasury, larger than earth itself, and recognizing, too, the further fact that without new accessions of vegetable matter successive dressings of mineral or fossil manures have been frequently found to terminate in impoverishment, and that minerals act as an excitement only to the manure furnished by the atmosphere," he adopted what he called "*the system of inclosing* [*against stock*] *to manure the earth by its own coat of vegetables*," *or* "*inclosing to fertilize.*" As the result of experience, he declared his belief in the impossibility of renovating an exhausted soil by resorting to fossil or mineral manures *alone*, because they expend the poor remnant of life in the ground as an excitement only.

THE TRUE SOURCE OF NITROGEN FOR THE FARMER.

"We must restore to the earth its vegetable matter before it can restore to us its bountiful crops. Facts demonstrate that by the use of vegetables we may collect manure from the atmosphere with a rapidity and in an abundance far exceeding that of which we have robbed the earth. To draw from the atmosphere the greatest quantity of manure to check the loss the earth sustains from evaporation during the process of shade, to give the manure the most lasting form, and to deposit it in the most beneficial manner, are primary objects of the '*inclosing system.*' The best agent known for effecting the three first is *red clover*. Its growth is rapid; its quantity exceeds the product of any other grass; it throws up a succession of stems in the same summer, and these stems are more solid and lasting than those of other grasses. These successive growth sconstitute so many distinct drafts from the great treasure of atmospherical manure in one year. While these drafts are repeated the clover is daily securing the treasure in a form able long to elude the robber, evaporation, whom it also opposes by shade. To its extracting from the atmosphere the greatest quantity of manure and elaborating it into a lasting form the most suddenly of any other vegetable cover, clover lays for wheat are indebted for their fame. The top root of the clover also advances the intention of the 'inclosing system' in several respects. By piercing the earth to a considerable depth apertures or pores are created for imbibing; and sinking deeper, a greater quantity of atmospherical manure, so well defended by the shade of the top, and the friability thus communicated to the soil affords a most happy facility to the plow for turning its vast bed of vegetable matter."

"Auxiliaries to clover powerfully accelerate its growth. The peculiar property of clover to be improved by a top-dressing of gypsum is another striking circumstance of

its affinity to the system of fertilizing land by its own covers. As its growth is vastly increased by this top-dressing, it furnishes reason to believe that the effect flows from a disposition communicated by the gypsum to the clover for imbibing atmospherical food in its external parts, and so much as it thus gains affords to the earth a double benefit. In some lands clover will not live; recourse must therefore be had to other measures of improving the land to endow it with a capacity to produce it, and substitutes for clover should be sought out by experience among the individuals of the vegetable world."

I have made these lengthy quotations from "Arator" to show the wonderful correctness of his views in regard to the improvement of poor lands on a large scale. That he was incorrect in the estimate put upon the value of fossil and mineral manures he admitted some years after these views were published, but still claimed "that vegetable matter only can bestow on gypsum, and perhaps lime and marl, a fertilizing power." In regard to systems of rotation and number of fields he says: "The *three-shift system* has only one merit—honesty. In theory it promises to kill our lands; in practice it fulfills its promise. The 'inclosing system' requires *four shifts* to succeed tolerably well without manure, and extremely well with it. From a long course of experiments my result is that with four shifts without grazing, one-fourth of a farm properly managed, after having been worried by the old rotation of corn, wheat and grazing, may in fifteen years be made to produce more than the whole would previously do."

The system pursued was to cultivate the larger proportion of his arable land in four fields, under inclosure, without grazing; all the stock being kept during the summer in what was called "a standing pasture." The rotation of crops was corn, wheat, clover, clover. The first year, corn, with gypsum, and all the manure made upon the farm, the land having been plowed deep in beds 5½ feet wide in the fall, and replowed again in the spring before planting. The wheat followed corn, and clover-seed was seeded, with plaster, on the wheat in the spring. The land was then allowed to remain in clover one year ungrazed, and the clover to fall on the land. The stock were fed upon the offal of the corn crop and the wheat straw in pens during the winter and spring, with the view of making all the manure possible, to be put on the corn land. The penning of the stock during the summer in movable pens also made a considerable source of manure. A certain number of small lots of land were cultivated in turnips, cabbages, pumpkins, pease, &c., which, of course, aided to some extent in the success of the system. Of the success he says:

"This theory can only succeed in practice in combination with a great number of agricultural practices at enmity with those which at present prevail.

"First. It is at enmity with summer fallowing for wheat, and is inconsistent with the doctrine that the earth will improve by keeping it bare.

"Second. It accords with the doctrine of turning in a clover lay, or a bed of any other vegetable matter, for a crop, speedily sown or planted thereon, without disturbing this new bed of vegetables, by which the previous stock of atmospherical manure in the earth is vastly increased and the least loss by evaporation sustained.

"Third. It is at enmity with shallow plowing.

"Fourth. It accords with deep plowing, because it enables the earth to absorb more atmospherical manure through the two great vehicles, air and water [nitrification], and because it buries deeper the manure deposited on the earth in a vegetable form; in one case inhaling more, and in both exhaling less.

"Fifth. It is at enmity with the custom of exposing a flat surface to the sun, and accords with an opposite one, because by the first the force of its rays in promoting evaporation is increased, and by the second diminished.

"Sixth. It accords with the fact that drought becomes far less pernicious to crops in proportion to the stock of atmospherical manure with which the earth has been stored to meet it, because by burying with the plow a copious supply of vegetable matter the moisture is retained in the earth."

He then says: "This system of '*inclosure to fertilize*' works so widely, so contantly and at so small an expense of labor, that properly used, it insures an annual improvement and a constant progress towards fertility. Human life is said to be short compared to what we know and conjecture of time. Within one-fourth of one of these short cycles I have known a fourfold increase of product from the same fields, produced chiefly by the inclosing mode of manuring. Without insisting on its title to pre-eminence, it is surely a powerful auxiliary to other methods of improvement."

I have made these long quotations not only to show that agriculture was not without true witnesses in behalf of scientific principles and practices in the early days of the republic, but to show that few theories have been better sustained than that of the noble old pioneer, John Taylor, of Caroline, in his operations in the improvement of worn-out lands.

That he was right in the main, and that any system which claims to improve worn-out lands most economically and permanently on a large scale must rest on the theory of returning nitrogen to the soil through the medium of vegetable matters and the

atmosphere, with the aid of fossil minerals, I propose to maintain in the further course of this article.

As an auxiliary mineral manure, the use of gypsum he seems to have been fully acquainted with, and says that "within the last ten years I have expended between two and three hundred tons of it in a variety of experiments, which have produced the conclusion that it increases very considerably the product of vegetable matter in almost all forms. It increases almost like compound interest, and in a few years land worth one pound an acre will become worth five." He then says: "Of lime and marl we have an abundance, but experience does not entitle me to say anything of either."

It seems very remarkable that the use of marl and lime in connection with "atmospheric" or vegetable manures should have escaped his acute perception, when they were used at the same time in other portions of the tide-water region of Virginia and Maryland.

The use of marl and lime, in connection with clover and pease, with *five* instead of *four* fields, or *shifts*, was the next step taken in the improvement of worn-out lands.

The earliest written account of the use of marl as a manure in this country that I have been able to find is given in Vol. II of the American Farmer, page 114, in a letter written by John Singleton, of Talbot County, Maryland, published in 1817, in which he says:

"In August, 1805, in digging down a bank on the side of a cove for the purpose of making a causeway, I observed a shelly appearance, which it struck me might improve clay soil. I took some of it immediately to the house, and putting it into a glass of vinegar, found it effervesced very much; this determined me to try it as a manure. Accordingly, in September I carted out about eighty cart-loads, and put it on a piece of ground, fallow, preparing for wheat, trying it in different proportions, at the rate of from twenty-seven to about one hundred loads per acre; and the ground was sown in wheat. I could not myself be satisfied that there was any difference through the winter and spring, although General Lloyd, who was viewing it with me in the spring, thought he could perceive some difference in favor of the marls; but at harvest-time the wheat, though not more luxuriant in growth or better head, was considerably thicker on the ground; and after the wheat was taken off, the ground where the marl had been put was set with white clover, no clover being on the ground on either side of it. The next year, 1806, I discovered it in the drain into the head of the cove, which I immediately ditched, and from the ditch put out seven hundred loads on the fallow ground; the effect as to the wheat and clover was the same, though the marl was not of the same kind as the other, but more mixed with sand and surface soil, being taken from the low ground by ditching, and all mixed together. I also tried it on corn ground, spread out as above mentioned, and found the effect immediate as to the corn; and in the same manner as above described as to the wheat sown on the corn ground. This induced me to persevere in the use of it, which I have done ever since. I have answered your inquiries as well as I can, except as to the average comparison as to the past and present crops, which I cannot well do; but I believe I shall not be much out of the way if I say that I think the soil now capable of producing between two and three times as much per acre as it would before I began to use the marl; and though the marl has not solely produced the improvement, yet the improvement would have been far short of what it is if it had not been for the marl, which has contributed in a very large degree towards it. And no small matter in favor of the marl is that, by the blessing of God on my endeavors, I have in twelve years been enabled to improve 300 acres of ground to the pitch that these are, and am now in a fair way of increasing in the same ratio that a snowball increases as it is turned over."

The truthful simplicity of this narrative adds force and character to the example it holds out for others to follow, and appeals equally to the present as it did to the generation to which it was given.

About the same period, marl was used very much in the same way by Philip Tabb, of Toddsbury, and Fielding Lewis of Bellefarm, in Gloucester County, Virginia, with excellent results. The former was the first to extol the value of timothy and other grasses from marled lands, and the latter was the first to burn oyster shells and apply the lime to the lands in tide-water Virginia.

In 1818, Edmund Ruffin, of Virginia, a man of indomitable will, energy and perseverance, commenced the use of marl systematically on the Coggen's Point farm, on James River in the county of Prince George, Virginia, extending its application to only 15 acres the first year; but by 1821 the area had been increased above 80 acres a year, and so continued until nearly all the then arable land on the farm requiring it—nearly 600 acres—had been covered. In 1821 his first publication on calcareous manures was made, of which he says: "Though the facts and reasoning thus made known were beginning to attract much notice, and to induce many persons to begin to marl, still it was some years later before incredulity and ridicule had generally given place to full confidence in the value of the improvement." At a still later period he says: "When nearly twenty-five years of my own experience of marling and its

benefits have passed, and the results are open to public notice and scrutiny, not half the persons who could marl are engaged at it; but there are scarcely any persons, however negligent in practice, who do not admit the great value and certain profit of applying marl wherever found. It required the improvement of marling in originally poor and middling soils [or liming, which in final or general results is the same thing] to render as generally available and beneficial the two kinds of vegetable manuring recommended by Taylor in "Arator." When such soils have been made calcareous by marling or liming, then, and not until then, all the benefits, present and future, that his readers might have been induced to expect may be confidently counted upon. This utilizing and fixing of other manures, and the fitting land to produce clover, which marling effects, would alone serve to give a new face to the agriculture of the country."

It is worthy of notice, in this connection, that while Taylor, in his "Arator," advocated the use of atmospheric or vegetable manures, to the exclusion of fossil or mineral manures, except gypsum, Ruffin, in the early use of marl, used it to the exclusion of all vegetable or nitrogenous manures, until he found that without a certain amount of vegetable matter in the soil the marl acted injuriously, and that when too large a quantity was applied, vegetable matter, especially in a green state, was the speediest corrective.* It was not until after this fact had been revealed to Mr. Ruffin that he formulated the proposition, which form the basis of his essay on calcareous manures. The uses of lime (stone lime and oyster-shell lime), although long known and practiced in Pennsylvania, and much earlier, and more extensively in Europe, were also known to many well-informed and reading farmers in this country. Such a one was Fielding Lewis, of Charles City (formerly of Gloucester), a most attentive, judicious and successful practical cultivator and improver of land. He is believed to have been the first person who used lime and the one who obtained the most manifest profits from it, and whose example had most effect in spreading the information of its usefulness. But some of his disciples and followers far surpassed their teacher and leader, to whom, however, they never failed to award the highest meed of praise for bringing it into use.

While it was from the example set by the men of character mentioned, scattered throughout the tide-water country, that this system of improving worn-out lands has developed into practice, and admitted as generally applicable, it was chiefly through the pages of the American Farmer, edited by Skinner, and the Farmer's Register, edited by Ruffin and his essay on calcareous manures, that information on the subject was spread most widely and cogently. In his essay on calcareous manures (published in 1842) Ruffin maintains in a series of exhaustive articles the following propositions:

First. "Soils naturally poor, and rich soils reduced to poverty by cultivation, are essentially different in their powers of retaining putrescent manures; and under like circumstances, the fitness of any soil to be enriched by these manures is in proportion to the degree of its natural fertility."

Second. "The natural sterility of the soils of Lower Virginia is caused by such soils being destitute of calcareous earth, and their being injured by the presence and effects of vegetable acid."

As a corollary to this it may be accepted, 1st, that all calcareous soils are naturally fertile and durable in a very high degree; and 2d, that all soils naturally poor are destitute of calcareous earth.

Third. "The fertilizing effects of calcareous earth are chiefly produced by its power of neutralizing acids, and of combining putrescent manures with soils between which there would otherwise be but little, if any, chemical attraction."

Fourth. "Poor and acid soils cannot be improved durably or profitably by putrescent manures without previously making them calcareous, and thereby correcting the defect in their constitutions." As a corollary, 1st, calcareous earth acts by completely preserving putrescent manures from waste, and yielding them freely for use; 2d, by their power of neutralizing vegetable acids in the soil; 3d, by altering the absorbency and texture of soils.

Fifth. "That calcareous manures will give to our worst soils a power of retaining putrescent manures equal to that of the best, and will cause more productiveness and yield more profit than any other improvement in lower Virginia."

Sixth. "The use of calcareous earth promotes cleanliness and health." Time and space in this article forbid that I should say anything in explanation of these propositions. Suffice it to say that, in the light of modern agricultural researches, I believe they can be maintained in theory and proved in practice, and that the system of farming developed out of them, known as "the five-field system of rotation," with marl or lime,

* The same difference of opinion subsequently existed between Baron Liebig and Mr. J. B. Lawes, Liebig advocating the mineral and Lawes the nitrogen theory. Subsequent experience demonstrates the necessity for a judicious mixture of minerals and nitrogen to insure the highest production and the fullest return to the soil.

clover and peas as green crops, in regular order with the cereal crops, produced the greatest improvement of worn-out lands in the shortest time and at the least expense ever known in the history of the agriculture of this country. Under this system large plantations in Virginia and Maryland, regarded as worthless for the cultivation of the small grains and grasses, were made to average 20 and 25 bushels of wheat per acre, and corn and grasses in proportion, in the course of eight and ten years.

In less than eight years, Edmund Ruffin (the soul of accuracy) was enabled to publish the fact that "the general annual grain products of his farms had been increased from three to four fold, and the net profit of cultivation and the intrinsic value of the land had been increased in a still greater proportion."

The many varieties and the respective value of marls form an interesting subject, which would be out of place in this article. Suffice it to say that, with all the neglect of using this means of fertilization, and with all the inattention to its manner of operating in soils, there never has been a system of improvement in agriculture attended with such beneficial and profitable results. And wherever they have been used with vegetable matters or in composts they afford a permanent fertility greater than that of any other fertilizers. If this be true, the question naturally arises, why is it that this system is not universally pursued now? Is it less applicable or less practicable now than then? Is it less beneficial and more expensive now than then?

To answer these questions fully would necessitate the consideration of too many factors, many the result of untoward events, to be introduced here. But this much may be said: Just as this industrial wave was bearing the system of improvement to all parts of the tide-water section of the Atlantic slope, 1850–'60, it was met and almost extinguished by another wave rolling in from the distant shores of the Pacific Ocean; a wave bearing on its crest hundreds of ships laden with "Peruvian guano," a substance containing all the most important elements of plant food in condensed form; a natural product, said to be, by the very nature of its origin and formation, inexhaustible; a product which, in chemical composition and intensity, must necessarily prove "a panacea" for all the ills that lands are heir to. By the less thoughtful and more easy-going farmers the advent of Peruvian guano was hailed with the greatest extravagance. Marl-coats were stopped; the five-field system of rotation of crops with clover and peas as green crops was abandoned; all the arable land of the plantation was to be cultivated every year with the "panacea" of three hundred pounds of Peruvian guano per acre, and fortunes were to be speedily made by the operation. Some even were so sanguine that it was waggishly suggested that the guano bags, thoroughly soaked and cleansed, would serve as garments for little "niggers," then merchantable articles, and be highly promotive of health and quick maturity.

Without doubt the first effects of Peruvian guano on the lands of the Atlantic coast were calculated to raise high hopes, and to lead the less thoughtful farmers astray. But that its use and that of its kindred highly ammoniated and nitrogenous fertilizers promiscuously applied to worn-out lands proved disastrous is within the memory of too many now living to be gainsaid. Wherever Peruvian guano and highly ammoniated and nitrogenous fertilizers have been applied to soils, worked down below the point of remuneration for profit and improvement without special preparation of the land, they have failed to realize either, because of the very nature of their constitution, the variation of seasons and the ill-judged application to all kinds of land. By their chemical constitution, ammoniated fertilizers are the most soluble, the most evanescent in their effects, the least permanent and the most costly. None, therefore, require more judgment in the using. It is for this reason that great pecuniary losses have been sustained and little or no benefit to the soil has been derived from their promiscuous use on a large scale. While the experiments of Lawes, Ville and others in continuous cropping of wheat on the same land with so-called "complete fertilizers," and highly ammoniated mixtures undoubtedly attest the possibility of such a system; it should be borne in mind that the subjects (soils) upon which their experiments have been conducted present geological, climatic and other conditions entirely different from those which obtain in this country. Here in a dry climate Peruvian guano and high-priced ammoniated and nitrogenous fertilizers have been used indifferently on thousands of acres of land, cultivated in wheat, corn and tobacco in quick succession, on soils of every description, undrained, clayey, sandy, loamy, calcareous, hilly, level, rocky, cloddy, in tilth and out of tilth, regardless of everything except the expectation or hope of obtaining a small profit after paying for the fertilizers. How this *hope* has been realized and the truth of the system has been tested the bitter experience of too many farmers can unfold. With an orderly system of crops, however, thorough drainage and preparation of the land and a due regard to the nature and constitution of the soil, highly ammoniated, costly fertilizers, one season with another, may be used with profit and improvement to supplement domestic manures. But as the principal means of improving worn-out lands and of making crops, no system has proved more costly or disastrous. The effect of their use has been to exhaust the soil of the few mineral and vegetable constituents it contained by their highly stimulating qualities, to impair the capacity for standing drought, and to impoverish.

This system has been called "the *guano craze*," and it culminated in 1861, just about the breaking out of the war between the States, during which period all of the best lands in the country were cultivated regardless of any system, and chiefly with the desire to obtain the greatest amount of produce. Indeed, it may be said that all systems were done away with, so that at the close of the war the plantations formerly best managed were, along with all others, in a wretched condition. The entire change in the system of labor put an end to the use of marl, and to a great extent of lime; the use of green crops and all systems of rotation were abandoned, and a large proportion of the lands throughout Virginia and North Carolina are cultivated to this day without order or system of any kind. Many plantations formerly productive are regarded as valueless. The average product per acre of all the cereals has been greatly reduced, and the lands are deteriorating every year. Is there no remedy for this evil? The success of the remedy will greatly depend upon the causes. It will not be denied that deprivation of all capital, except the land, and an entire absence of all system in working and improving it are the chief causes operating now. The immediate remedy is in the more active exercise of the capital stored in the brain, to put in practice methods which experience has taught to be the best for securing profit from capital in land. The bountiful deposits of marl only await the mule and the cart; the land awaits the division into five or more shifts; the peas and the clover await the seed-time and the turning in with the plows. If these are insufficient, they may be cheaply supplemented by the phosphate of lime and the cotton-seed; and by the time one rotation has been carried through the produce will be increased fourfold. On average lands this has been done repeatedly in the past, and why cannot it be done now? Mr. Ruffin estimated the cost of putting 572 bushels of marl per acre on his Coggins Point estate at $7.50 per acre. Half that quantity, which is enough for ordinary lands, can be laid on now for the same amount. How often have we seen $7, and even $10.50, worth of commercial fertilizers applied to the acre without profit or permanent improvement of any kind to the land!

Two hundred bushels of good marl, or half the quantity of lime, applied to the acre of ordinary land in the tide-water section, followed by peas and clover, will show its fertilizing effects for two generations. I maintain that lime is an element that must be supplied in some form in all rational efforts for the permanent improvement of the *siliceous soils* in the tide-water and granitic sections of the Atlantic slope. "The fact," says Professor Johnston, "that granitic soils never naturally include more than a trace of lime will satisfy any one who believes the presence of lime to be necessary in a fertile soil as to the first step to be taken in endeavoring to rescue a granite soil from a state of poverty, and will explain the reason why the use of lime on such soils should have been practiced so long with the best effects."

It may be added that the action of lime in the soil is not only valuable because it decomposes organic matter of putrescent manures and green crops into humus, and the organic bodies of the "humus group" holding ammonia, but that it unites with these bodies as a chemical agent or flux to break down the insoluble silicates of the soil to coagulate alumina or clay, and to liberate potash and other alkalies from their mineral combinations. It is in this way that lime and vegetable matters, plowed in, change the whole character of the soil. I repeat, then, a belief founded upon an extensive observation and experience, that large areas of land of this character now in profitless cultivation may be improved more cheaply and made more permanently profitable by this than by any other method that can be adopted. By reference to the second annual report of the New Jersey State Agricultural Experiment Station, 1881, it will be seen (page 39) that with the comparative use of the same fertilizing mixtures on trap-rock soil, red sandstone, red shale, mixed sandstone and clay soil, clay-marl soil, marl soil, and oak-land soil the crop of Indian corn and stalks on the marl soils was largely in excess of those of all the others. This sustains the proposition that I have maintained for years, that it is only after lands of the tide-water and granitic regions have been prepared by the use of lime and green crops that high-priced ammoniated fertilizers can be used with profit on them. The soil must be in a condition to hold moisture through the agency of vegetable matter, and to retain the nitric acid and ammonia for the uses of the plant during the growing season, whether wet or dry, and this is effected by the action of the lime on the one hand and the humates of the vegetable matter on the other. Neither lime nor any other mineral substances will accomplish this alone, nor will vegetable matter accomplish it alone. They must be used together. While there is no positive evidence to show that nitric acid or ammonia is fixed in the soil in the absence of growing vegetation, the practical truth remains that lands treated on this system stand drought better, produce better crops, and steadily improve without the application of costly nitrogenous fertilizers. It goes without saying that in all cases the nitrogen required is furnished mainly by the decomposition of the green crop. Mr. Lawes, the greatest advocate of the use of nitrogenous fertilizers, in a letter to the "Country Gentleman" of April 13, 1881, says: "One fact is perfectly clear, that whatever may be the source of the nitrogen in clover the plant furnishes that substance in the cheapest possible manner, and so long as

good crops of clover can be obtained the farmer need not have recourse to any costly artificial compounds for its supply." That there is no plan or process known by which good crops of clover and leguminoid plants can be obtained as surely, as speedily and as permanently as by the use of marl, lime, or gypsum and phosphates, is a matter of common observation and experience. If this be true, it follows as a consequence that there can be no cheaper method of obtaining nitrogen in the soil than by the conjoined use of lime in some form and leguminoid plants plowed in.

The beneficial effects of a good application of marl or lime to the soils in question may be seen for years, and its application becomes a permanent investment added to the capital in land.

The theory, as well as the practice on which this system is based, is one known as "*mixed farming*," with a fair proportion of stock, by which one crop is made to supplement as far as possible the loss entailed by another, and domestic manures and commercial fertilizers are used to supplement the losses entailed by each particular crop in rotation. But objection is made that this is an old and obsolete system, not adapted to the spirit of the age and entirely inapplicable to the improvement of worn-out lands on a large scale, and others of "a readier method" must be adopted to yield good profits and quick returns. I will not take time to refute this idea. That this can be done by attempting high farming on worn-out lands with high-priced commercial fertilizers, few real farmers will maintain.

Of the system now recommended with commercial or mineral fertilizers, the one first made known by the late lamented Dr. St. Julien Ravenel, of Charleston, S. C., is based upon the soundest principles of natural science, and is sustained best by practical observation and experience. The experiments elucidating this system were conducted on the extremely barren and sandy soils near Charleston. This system is based upon the idea: 1st. That the nitrogen in the soil must be obtained naturally from the atmosphere by plants grown on the land, and plowed into the soil; 2d. That the soil is a mere "*caput mortuum*," without the mineral constituents in available form or quantity to support vegetation; and 3d. That in order to secure an immediate growth of plants, the mineral or "*ash elements essential*" must be added and commingled with the soil in available form. This idea is the same as that announced by John Taylor, of Caroline, in "Arator" in 1810, that we must look to the atmosphere through the medium of vegetables, chiefly to restore the soil to fertility; only it goes one step farther, to furnish the "ash elements" to feed the plants to furnish the the nitrogen, to make the process complete.

This hypothesis is also substantiated by the experiments of Sir J. B. Lawes on the necessity of nitrogen, showing that the plot successively in wheat for forty years, with large dressings every year of potash, soda, magnesia, and superphosphate of lime—that is to say, everything to grow a large crop but one, *nitrogen*—hardly produces more than the unmanured plot cultivated for the same period, while the plots with minerals and nitrogen added, in different proportions, increased the crop during the same period 14 to 40 and 50 bushels per acre. I would ask, what difference does it make whether the all-important factor, nitrogen, is furnished in the form of nitrate of soda, sulphate of ammonia, organic forms of nitrogen, or as green leguminoid crops plowed into the soil, except in the matter of a little more time for the nitrification of the green crop? The maxim that "time is money" may be true; but it is equally true that all processes for *the permanent improvement of land* necessitate the element *time*, however it may be valued as money.

This hypothesis is still more strikingly borne out in the philosophic truth of nature's own work in the formation of fruitful soils. The plan of nature in the formation of soils is first, the disintegration of the bed rock through agencies of water, in freezing and thawing, atmospheric air and rain-water charged with carbon dioxide; second, the growth and decay of the simplest forms of vegetation, and thence on to the growth, death and decay of higher forms of plants, until earth mold or humus and mineral constituents are accumulated in sufficient quantity to constitute what is known as a fruitful soil—a soil not only possessing the elements of plant food, but all the physical conditions necessary for the development of the highest plants.

The practical methods adopted by the gifted Ravenel (whose death in the meridian of life is the whole country's loss) to carry out this hypothesis are, to supply the soil with the mineral or "ash elements" and phosphates; to sow the seeds of the native vetch (partridge pea), field pea, clover or other leguminoid, as atmospheric media; to collect and concentrate nitrogen; and then to plow this crop into the soil, to be acted on by the minerals, and to undergo the steady process of nitrification to supply the daily and hourly necessities of the cereal crops which follow in course. The beneficial effects of this process of improving worn-out lands are not alone due to the fact that it enables us to procure a supply of nitrogen in a cheap and most permanent form, but that the decomposition and decay of vegetable matters constantly going on in the soil, exposed to the scorching rays of a southern sun, preserve the moisture and prevent the injurious effects of drought.

This method has been submitted to the test of repeated experiments on the sandy

soils of the South Carolina coast, and has been the means of producing the most astonishing crops of legumes, cereals, grasses and cotton. It has been adopted in the Carolinas and the Gulf States, and it cannot prove less applicable to the soils farther North.

In 1874–'75, long before I had seen or knew anything of Ravenel's experiments, acting upon the same principle, I reclaimed land in a condition far worse than that on which he operated, comprising an area of more than five acres, denuded of its soil from the depth of 18 inches to 3½ feet to make an adjacent railway embankment, a greater portion of it covered with bottom water, and the whole devoid of vegetation of any kind. Of course, the land had to be drained, which was the most expensive part of the operation. The process of improvement then consisted in deep plowing, liming, the repeated seeding of pease, with a mixture of plaster, salt, ashes and phosphates, and the plowing in of the pease. In two years this land was cultivated in corn, with a little manure in the hill, and phosphate of lime sown broadcast with pease at the last working of the corn. Notwithstanding an excessive drought, the corn made over 20 bushels to the acre. The corn being cut off, the pea vines were plowed in and the land seeded in wheat, with grass seeds and clover in the spring. The wheat yielded 18 bushels to the acre, the clover and grass seeds took, and the yield of hay for the last two years has averaged over 2 tons to the acre, with a fair prospect of producing the same another year, with the addition of a moderate top-dressing of plaster and ashes. Thus a "*caput mortuum*" was made a fertile soil in less than three years. A portion of this land has produced at the rate of 38 bushels of wheat to the acre.

The systems of improving worn-out lands on the Southern Atlantic slope which I have narrated are not fancy sketches, but are drawn from real life, and are wrought out of materials mostly obtained within the precincts of the farm itself, as being those readiest at hand to accomplish the work of improvement. The whole region of the Atlantic slope is bountifully provided with all the materials necessary for the restoration of the worn-out lands cheaply and economically, by means of which they may be brought to a high degree of fertility and made to pay equally as well as the lands of the West. Inexhaustible beds of miocene and eocene marl and phosphate beds, with a great variety of pease and native vetches, only await the using; and ensilage, corn, pease and cotton-seed meal afford unlimited means for the raising of cattle, sheep, hogs and horses. All that is required to accomplish this is a small amount of capital, the development of orderly plans of procedure adapted to the special wants of each section and locality, and the exercise of faith, energy and brain capital in carrying out the processes recommended. While I would not be understood as detracting from the capacity of farmers to learn by preceptive and theoretical means of instruction less than the followers of other kindred associations, I think it may be stated without fear of offense, that the average farmer on the Southern Atlantic slope is not prepared to work intelligently and profitably without some well-devised plan or pattern given him to follow. Seeing is believing, and his more enlightened neighbor should be expected to set him a good example. The work of experiment stations and of agricultural colleges, however practical, does not reach him, yet both are in a way to help him. The time is coming when he may be educated to that point, and that is the great office of these institutions, which should be maintained to the fullest extent of usefulness for that purpose.

The only way to reach the average farmer now and to elevate him, I repeat, is by some well-devised plan of farming, thoroughly executed by his more intelligent and appreciative neighbor, whose precepts are impressed through the force of example upon his less instructed but impressible mind.

That the enlightened wisdom and experience of the agriculturists assembled from all parts of our country in this association will aid in this and other useful work, there can be no doubt. But, as I have already said, time presses; the lands of the great West are being exhausted; there is very little more good virgin land to be brought into cultivation; the population of the country is doubling every twenty-five years; the average production per acre is annually diminishing; and the time is not far distant when the exportation of cereals must diminish and seriously interfere with the balance of our trade with foreign nations.

Believe me, this is not only the most important problem for the people of the States of the Atlantic slope, but it is one which the Federal Government should consider, in order to promote by every constitutional means methods for the improvement of the art and science of agriculture. To accomplish this result, dignity and authority must be accorded to the agriculture of the country in proportion to the interests involved in it. Agriculture should be made a co-ordinate branch of the Government, with an executive officer qualified to suggest, to encourage and to report upon all improvements calculated to build up the soil, to increase the products of the country and to give aid and comfort to men engaged in scientific researches for its promotion. It should be borne in mind that, to call forth the powers of genius in art and science, it must have freedom and authority to enable it to apply its undivided energies to the

lofty purposes for which it was given. To stimulate its noblest ambition and call forth its mightiest spirit, honors and dignities must be placed within its reach. It is from the union of insulated labors and from the stimulus of combined exertion that great achievements spring. The chivalry of agricultural science incorporated in societies must receive the aid of the State and Federal governments; and when this shall have been done, we may look for researches and improvements in the agriculture of the whole country, which will cause the tide of population to cease its westward flow, to fill up the country equally and to build up the waste places everywhere.

Mr. GAINES. Referring to the use of lime, to which Professor Page alluded in the history of the introduction of lime, the use of it in Virginia and its success, I know from personal observation that it has been utilized with great success in tide-water Virginia and is still used, both as a sulphate and a carbonate, in the Valley of Virginia, which is of limestone formation. But in my section I see no effect from using the sulphate or the carbonate, whereas the phosphate of lime, particularly the superphosphate, is the most vital fertilizer we can apply to the soil. I would like to have the professor's opinion upon that point.

Professor PAGE. I beg leave to state, Mr. President, it is a very common thing to hear of instances of that kind from particular sections of the State. The remarks contained in that paper are confined to the easternmost trend of the Appalachian chain. But in the Piedmont section, where the soils are gray and red, and with a very small strip of land with limestone, running along the line of Gordonsville, lime seems to be less effective. I have heard numbers of persons say so. But I can take you to a farm now in Albemarle County, which was purchased many years ago by one of the original professors imported by Mr. Jefferson. He was a German, and the first thing he did after retiring from the university was to make kilns of lime, burn and apply it at the rate of one hundred or one hundred and fifty bushels per acre over his whole farm. I will pledge you, there is more grass to the acre on that farm than on any other in the whole region.

You do not see the effects of lime in one year, or perhaps in two, unless you put native crops with it.

The lands which do not produce clover are the gray lands. Now, persons come frequently to ask me why it is that plaster does not act as formerly. I cannot answer the question; but I say if the plaster does not act, use carbonate of lime. The impression prevails throughout the country that, whereas plaster formerly would produce clover and make it grow, it will not do so now.

The Chairman then invited Mr. Ford, of Maryland, to read his paper on Fruit Culture.

Mr. FORD. I have a paper that I should be very glad to read when there is an opportunity. The paper intended to be presented here had not been provided as was expected, and I feel compelled to give the reasons. The paper I wish to read has reference more to small farming and small farmers of the more numerous class—the farmers of this country who are working small parcels of land. I think I fully represent that class when I say that I raised my own family to manhood and womanhood, never farming more than seventy acres.

FRUIT CULTURE.

By MILTON FORD, *of Maryland.*

It has been truthfully said that bread is the staff of life; truthfully, because bread made from the cereals used by man contains all the elements essential to the development of his mental and physical capacities, and doubtless from childhood to mature age, neither mind nor body would be much the loser if good bread and pure water should constitute the only diet. Neither do I think, if this diet were continued

through life, would man be less able to fulfill the divine command to obtain his bread by the sweat of his face; and if the healthful fruits created for his use, whether from plant, shrub, or tree, dressed and kept by his skillful hand, were added, would his length of days be shortened.

But, Mr. President, by these few remarks I do not wish to be understood as being opposed to flesh food, either upon moral or sanitary principles. Morally wrong it cannot be, because permission was given by the Creator of all living things to the entire human race, as represented by the eight persons left alive from the deluge—"Every moving thing that liveth shall be meat for you; even as the green herb have I given you all things!" If not healthful to the human system when slaughtered and prepared in good condition, it certainly would not have been given. No scientist or anatomist, however learned, can ever understand our wants so well as Him who granted that permission. But I do contend that the American people, as a whole, do consume more flesh food than is needful. If not positively injurious to good health, it certainly is to our pockets. Especially is this felt by the laboring masses, struggling to obtain food for their dependent families. The cry in all our overcrowded cities reaches heavenward, not for meat, but for bread. The beggar who comes almost daily to our doors begs for bread, not meat. Therefore, let our best efforts and the efforts of this Department, aided by liberal appropriations, be directed to solve the overshadowing problem of cheaper bread, supplemented by abundance of cheaper fruits. Would not this be the wiser and more prudent course, considering the astonishing increase of our population and the consequent lessening of the area of arable land? Is it not time to devote less money and brain to the best-paying breeds of flesh-producing animals, more in the direction of quantity than quality, or of favorite breeds with butchers, in order to obtain the highest prices, with but little benefit to the more numerous class of small cultivators? Devote more time, money and brain to produce bounteously of breadstuffs and fruits, so that this goodly land may become the Egypt of the world, as nature seems to have designed it.

I am in favor of largely increasing the production of breadstuffs and fruits, with good supplies of vegetables, so that the production of flesh for food shall be of secondary importance. It seems to me the importance of fruit culture is not sufficiently appreciated, even as a food product, excepting, if you please, its excellent sanitary uses. Especially is this the case in families of children. It also applies to adults, but not in so large a degree. If they have bountiful supplies of fruits, such as good apples, peaches, pears, grapes, &c., children will consume far less breadstuffs, have little or no desire for meat, and would be quite content without it so long as the fruit lasts. Even the laboring adult, if he have plenty of good well-ripened fruits, will also eat far less bread and meat. Apples and peaches have large fattening qualities for animals without the help of grains. Especially is this the case with sweet varieties for cattle and hogs. Hogs will thrive well on peaches; so will geese and hens on both apples and peaches. In my judgment it would pay well to raise sweet apples for stock only. Trees can always be set where they will take up little room, and if well set will grow and thrive with little labor. I have never lost a tree set by my own hands, and have succeeded in raising the finest fruit for size, shape and flavor in the following manner:

After well setting the tree I mulch it with whatever vegetable matter I may have at hand—chip manure, hay, straw, or leaves. If in need of more mulch next spring I apply it; I make strong lye from wood ashes, and with saturated cloth rub the body up and down well with both hands. I follow up that process every year, no matter how old the tree. In the second year, keeping the trees well mulched, I slit the bark to the wood the whole length of the body, taking care to prune well from center outward. I also prune the top down, keeping the whole top well pruned to give the body chance to grow vigorous and strong. Every year I prune the top limbs so as to conveniently gather the fruit. I always keep the suckers and inside limbs well pruned to let in plenty of sun and air. Peaches and pears are treated about the same way. Thus, with little labor, the small farmer may have abundance of fruit at small cost, and his tree at the age of three or four years is worth more to him than a steer of same age, and double the sum to the community. The steer is slaughtered and gone, but the tree, year by year with very little cost, will continue to grow more and more valuable for at least a quarter of a century. If well taken care of, at the end of fifty years it will be worth more than fifty short-horns.

Mr. President, the few views I have so hastily and imperfectly sketched are individually my own, and they may or may not be those of any of the members of the Potomac Fruit-Growers' Association, which, in part, I so poorly represent. I was not charged with the duty of presenting any paper to this Convention touching the origin, date or objects of its organization, and the many good results that seem to have been accomplished in and around Washington. The gentleman whose ability best qualified him for that task and upon whom reliance had been placed to prepare a suitable paper, has been prevented from so doing by press of business. Should a Convention be called here another year the disappointment will not again occur. Believing, however, our

climate and soil to be well adapted to fruit culture, the association will not slacken its efforts to promote the objects for which it was formed, as indicated by its name. We fondly hope we may yet see the day when this market shall be cheaply supplied, not as now from abroad at high rates, but from the near vicinity, at prices within the reach of the laboring classes.

Mr. GAINES, of Virginia. I now move, Mr. President, that this Convention adjourn *sine die*.

The PRESIDENT. Before submitting the motion, I would say that the report of the Convention will be properly made up, condensed and published at the pleasure of this Department. If there are any papers sent to the chair hereafter which gentlemen have not had the opportunity to present, they will be included in the report.

[After putting the motion.]

The motion prevails and now, thanking you one and all for the interest you have shown and the part you have taken in this the second series of Conventions held under this roof since my administration of the Department, and hoping that you have derived much benefit from the valuable papers and deliberations to which we have listened, I declare this Convention adjourned without day.

APPENDIX.

The following interesting and valuable papers, contributed to but not read during the proceedings of the Convention, are herewith appended:

THE LIVE-STOCK INTERESTS OF TENNESSEE.

By Col. B. F. Cockrill, *of Tennessee.*

Having been requested to prepare an essay upon certain matters set forth in the circular of the 17th of December, 1882, I should have taken great pleasure in complying more fully as to particulars. But being limited as to time, I propose to confine myself to a general review of the live-stock interests of our State.

Tennessee, situated as she is, in a central position of the sisterhood of States, where the climate of the North and of the South overlap as it were, has a most advantageous position for the development of live-stock industry. Composed in a great measure of soil formed by the disintegration of her limestone deposits that are so productive to the best grasses, her climate being so uniform, rarely experiencing the great vicissitudes of weather incident to a latitude farther north, would seem to warrant the conclusion that our State should be much further advanced, and that the capital invested in this industry should represent a much greater aggregate than the census report shows. This I attribute to two causes; first, to the incubus of slavery, and secondly, to the fact that the great productiveness of the soil afforded a competence almost without exertion of either the brain or the body. Yet, with our nearly 27,000,000 acres, and only about one-quarter of that actually available and utilized, Tennessee represents about $60,000,000 invested in live stock, and the farms upon which they are fed and grazed about $120,000,000 more, making in the aggregate nearly $200,000,000 directly represented by this branch of husbandry. This is about the eighth position in this respect in the sisterhood of the States. Tennessee being so admirably adapted to live-stock industry by both climate and soil, is rapidly being converted (since the new era of prosperity has dawned upon us) into a grazing and feeding State, and the time is not far distant when this interest will be quadrupled. I shall now pass in cursory review the different branches of this interest.

First, the blood-horse, or thoroughbred, as the latter title, although often misapplied and misused, belongs properly to no other equine family. As early as 1790 many animals of this strain were introduced into the eastern portion of our State, and from thence distributed by the pioneers all over its territory. The stirring times incident to that period in the many contests with the red men, together with the experience of the Revolution, demonstrated the vast superiority of this race of horses over all others for endurance, game and unflinching courage under the greatest hardships or the scantiest of diet. This fact inculcated a natural affection between our hardy pioneers and their horses, which has been transmitted from sire to son down to our present day.

The early introduction of the thoroughbred into Tennessee explains the reason why the horses of our State are of a much higher standard than those of most States of this Union. This fact will not be questioned by those who will investigate the records of the turf, or the markets where Tennessee horses are sold. This result is also due in a great measure to the fact that, for the past three-quarters of a century, this branch of husbandry has received the attention, time and means of many of the most enlightened minds of our State. No less than fifty imported stallions have been used in Tennessee, in addition to the greater number bred from the best importations. The excellency of the far-famed horses of Kentucky is perhaps due more to the introduction of blood from Tennessee than to any other source, and while at the present time they exceed ours in numbers, they do not excel in quality. These two States were perhaps the only rivals in the production of this, the highest type of the equine race, until recently a large number of intelligent capitalists of some of the Northern States have devoted their time and money to the production of this noble animal.

I am aware that many in the North (none in the South) will be disposed to question the assertion that the thoroughbred is the highest type of the equine race. But to those I would say, look to history of the march of armies, day after day without food; investigate the incidents of remarkable endurance and feats almost beyond belief that have been performed by individual animals, where their ancestry could be traced, and you will find them either thoroughbred or largely inbred to that race; for instance, such as General Frémont's ride across the plains of 600 miles in six consecutive days; 20 miles within the hour, by the noted trotter "Trustee;" 100 miles in ten hours by "Conqueror," or the still more remarkable feat of the Duke of Gratton's little thoroughbred mare standing up for a wager under more bags of sand than the largest dray horse in London. History multiplies such examples without number, and their great beauty also commends them to all. All statuary, where the horse forms a conspicuous and prominent feature, comprise this type for models. Notably the statue of the Duke of Wellington, who is seated upon a model of the celebrated racer "Recovery"; Napoleon, upon his beautiful white Arab; our own Washington upon one of his thoroughbreds, and the old hero of the Hermitage upon his celebrated racer "Truxton," whose statue now adorns one of our noted squares in Washington.

The circular asks for the breed, size, shape and temper of the horse best adapted to the United States, and my answer to this is that the general purpose horse is a myth. There can be no horse adapted to all purposes over so great an extent of territory, so many vicissitudes of climate and such varied demands. Each community must first determine what is wanted, from close observation and long experience, and then adopt the thoroughbred for a foundation, from which they must breed to suit their wants. I say thoroughbred, because he is the most potent, best organized, hardest bone, least lumber, or useless adipose tissue, best breather, larger heart in proportion to size of body, readily oxydizing his blood to supply waste tissue, and consequently possesses more power to discard that which is useless than any other breed in the world. This is necessarily so, for the reason that he has been handled longer by intelligent minds than any other race. As the machine is improved its demand increases, and this is equally so of domestic animals. The trotter, if proof of these facts were necessary, clearly demonstrates all my propositions; since the roadster, as he is called, has become the fashion and luxury of the rich, representing fabulous prices, and the test of whose speed, being the most crucial of all tests, taxes the animal economy greater than any other. The attention of breeders has been so critically directed to lines of blood, the fact has been developed into great prominence that the pedigree of all distinguished performers is and was largely infused with the thoroughbred. At the present time it can be asserted without successful contradiction that every prominent stallion, as a sire of horses where speed is a requisite qualification of value, is and must be largely imbued with thoroughbred blood. This being a fact, great endurance, under either slow or fast work, must be derived from the same source, because they are dependent upon like adjustments and functions of the animal economy. Consequently, I say the thoroughbred presents the foundation for all excellence of a certain character that can be found in no other family. A certain kind of action peculiar to different families and strains may be the objective point for which you desire to breed and cultivate; but the power and ability to maintain that peculiar action during a long-continued cultivation, must as certainly be derived from the animal which possesses the highest or most perfect organism, as that oxygen is necessary to combustion. This, in the equine family, is possessed only by the horse which traces its descent from the desert horse of Arabia. Size, temper and traits in the horse are neither more nor less than the products of feeding, management and skill in breeding and handling. Those persons who are qualified to breed and rear a horse to perfection, are probably more rarely met with than human educators of merit, for the reason that the human being can make known his requirements, the mere animal cannot, and but few men possess the intelligence to understand the language of animals.

OUR CATTLE.

As early as 1828 the great necessity for the improvement of the native cattle of Tennessee attracted the attention of several gentlemen of means and intelligence, who made importations from some of the celebrated herds of the far-farmed Short-horns of England.

At that time these cattle, which had been bred to a high degree of perfection in the valley of the Tees in England, were attracting attention all over the world. From this importation, which was very popular, sprang several herds, the descendants of which were scattered almost over the entire State, and left their impress up to the present time. But our best herds of the various breeds date back their history only to the declaration of peace in 1865. The late war was probably more destructive to this branch of the live-stock industry than to any other. So much was this the case that at one period the low of a cow was the signal for a foraging raid. The consequence was, that but few cattle were left within the limits of the State. But this industry so indispensable to rural prosperity, has rapidly recuperated, and is perhaps repre-

sented at the present time by from twenty to thirty millions of dollars. The breeding interest of the improved breeds of cattle is perhaps extending as rapidly in Tennessee as in any State of the Union. We have at the present time about forty herds of thoroughbreds, representing Short-horns of the most approved families, such as "Dukes" or "Duchesses," "Roses of Sharon," "Young Marys," "Phyllises," and many others regarded as the *ne plus ultra* in breeding and distinguished lineage. The "Jerseys" are represented by the celebrated "Coomassie," "Alphea," and all of the most noted families celebrated for their milk and butter tests. I may safely say that within a circuit of forty miles of Nashville there are more high-priced "Jerseys" than within the same area elsewhere in the United States.

The dairy interests of Tennessee have been sadly neglected until recently. The natural adaptation of the soil and climate is rapidly forcing itself upon the minds of our people, and dairy interests are destined to be one of the largest items of export from the State within the next decade. Butter from Tennessee is at the present time being shipped to Cincinnati, Chicago, New York, Philadelphia and other cities, receiving the most favorable mention from dealers in those places. In view of the fact that the dairy interest of the United States has grown into such stupendous magnitude, so largely sought after by foreign countries as an article of food, I regard Tennessee as destined to take a very prominent position in this industry, and I know of no more favorable location for the investment of capital in this branch of husbandry than the central basin of our State.

In order to direct attention to the importance of this industry and the great magnitude it will assume at no distant day in supplying food to the human family, allow me to digress a little. There are at present about 350,000,000 human beings in Europe and America to be fed. This vast horde receive three-quarters of their sustenance from the direct application of labor to soil. The farmer wants to raise food that will give the toiling millions pure and healthy blood at the least cost to them, and with a profit to himself. To do this with the greatest economy of labor capital and satisfaction, the dairy cow comes in as an indispensable agent and an indispensable factor in the problem. Allowing an ordinary dairy cow to yield only 20 pounds of milk per day for 200 days of the 365, and you have an annual yield of 4,000 pounds. Now what is the value of 4,000 pounds of milk as compared with the number of pounds of beef made from the same feed? An average three-year-old steer or heifer will give about 750 to 800 pounds beef. This assumes that a dry cow yields about 250 or 260 pounds of beef from the same feed that produces 4,000 pounds of milk. If we take 10 pounds of good cow beef and dry it perfectly, it will lose about 7½ pounds, leaving 2½ pounds solid matter. If we take 20 pounds of new milk and reduce it to solids, the loss is 17½ pounds, leaving the same amount of solid matter as the beef. Thus it will be seen that a cow or steer must annually yield 2,000 pounds of beef from the same feed necessary to produce 4,000 pounds of milk from the dairy cow, which is an absurdity. Now if the component elements in new milk are worth as much, pound for pound, as beef, excluding all moisture from both, it then follows that all forage plants or food of whatever kind fed to the dairy cow yield mankind ten times more healthy blood than beef. This fact is becoming known all over the civilized world, and is rapidly bringing the dairy interest to the front rank in agricultural pursuits. To-day in America it stands in its aggregate value as second only in industries, the first being the production of the staff of life, corn.

Considerable attention also has been directed in our State to a breed of cattle, the "Devons," a race destined to be an important factor in the South and West. Being smooth, medium-sized animals, of quick and thrifty growth, small consumers for the amount of rich secretions yielded either in the way of beef or milk, well adapted for short pasturage, as little liable to the ailments of the bovine family as any other race, these qualities commend them to our country from here to the Gulf of Mexico. I regard their introduction into the vast herds of the West as necessary, from the fact that a great deal of territory must be traveled over after sustenance, and the "Devon," being a quick, active traveler, would not only suit this condition, but supply his aptitude to take on flesh of the finest marbled character. Large cattle should not be grown or sought after on the plains, but only in the States, where feed is abundant and grain cheap. I therefore predict that the most intelligent ranchmen of the West will very soon adopt the medium-sized races, active on foot and quick feeders, for making fine, even-fleshed animals at an early age.

SHEEP.

There is perhaps no State in the Union that for climate and physical features excels two-thirds of the territory of Tennessee for the successful prosecution of the important industry of wool-growing. The extensive plateaus and table-lands of the eastern division of our State could not be fashioned by the hand of the experienced flock-master better to his ideas and tastes than they have been created by the master hand of Providence, possessing not only the physical features necessary for the health of the ovine race, but clothed over thousands of acres with a spontaneous production of the most nutritious grasses. Red top (*Agrostis vulgaris*) grows in the greatest lux-

uriance where never a seed has been sown. I have seen the Swiss, from a native colony settled upon the Cumberland plateau, cut out of the woods a ton of pure red-top hay per acre. About sixteen varieties of leguminous plants are found growing here in luxuriance and abundance, all of which furnish fine grazing for sheep; yet, with all these natural advantages, these lands lie idle and unutilized. Why is this? I can only answer that it results from want of proper legislation and a failure of appreciation of our natural resources. I mean such legislation as not only Tennessee needs, but nearly all the wool-growing States of the Union, in regard to depredation by dogs. At least 10 per cent. of the flocks of the State are annually destroyed by worthless curs. Thus you see an industry yielding a larger per cent. for investment than any other—or else it would be totally abandoned—crippled and retarded in its development by the lack of wisdom of our law-makers. Do we not witness the same want of appreciation of this great industry on the part of our national law-makers by removing the tax from foreign wools, and still further enacting the suicidal policy of giving foreign countries the contract for the clothing of the human family, thus depriving America of one of her greatest industries?

Notwithstanding the drawbacks to the production of sheep, our State is making good progress by the introduction of the improved breeds. There has been but one flock of pure Merinoes bred to any extent in Tennessee, namely, that of the late Mark R. Cockrill, who was the pioneer in this variety of stock. He began his flock in 1814 from the importation of Mason and Jewett, and bred them continuously pure to the time of his death, which occurred in 1875. This flock became noted, not only in Tennessee but all over the United States, and was known of in Europe, especially by his successful competition at London, at the World's Fair in 1850–'51, at which he received a medal for the finest wool on exhibition. This flock was also successful at numerous other competitions, among others at the exhibition of textile fabrics held at Cincinnati, where he was accorded a gold medal for the best exhibited specimen of wool. This evidence must be taken as conclusive that Tennessee can produce as good wool as any other portion of the world. Lately the mutton varieties have claimed the most attention from our agriculturists as affording quicker returns upon the capital invested, and not requiring such care and skill in handling and breeding.

In many instances coming under my observation the combined value of mutton and wool from flocks of the improved mutton sheep has been as much as 100 per cent. per annum upon the investment.

The annual cost of keep per sheep in Tennessee will not exceed one dollar per head. During some very severe winters sheep should be housed in our climate; but during our average winters they do well without other protection than the natural forests, when provided with abundance of pasturage, which can always be had by sowing wheat, rye, or barely in the fall.

The eighth query of the circular I would answer as follows: The sheep best adapted to American agriculture is determined by the locality of the flock-master. If near a market, located upon high-priced lands, wool should be secondary, mutton primary. The best variety for the latter purpose must be determined by the fancy of the producer, since there are several breeds nearly equal as meat producers. My preference in this latitude is for the improved "South-Down," it being less liable to disease from long, dry, hot months, and, in my opinion, is a quicker feeder than the larger breeds. They also produce a staple of wool admirably adapted for the medium grades of cloth, such as are worn by the million. Upon the plains of the West, where the flocks are numbered by the thousand, and in many localities unprotected from the storms of winter except by such shelter as the chapparals afford or the lee side of some hill, there the Merino, like the blood horse, must be the saving cross. They are now acknowledged to be the only variety of merit that can be herded in large numbers without detriment. In such localities wool must be the primary and mutton the secondary consideration. On the vast ranches of the West, according to the demands of the people and the invention of machinery to produce cheap clothing, the Merino and its crosses will take the lead and furnish the type of sheep produced. When we consider the fact that we are yet importing from 40,000,000 to 60,000,000 pounds of wool with which to clothe our own people, together with the fact that millions of acres abounding in luxuriant pasturage are not yet occupied, this interest looms up with a grandeur that should encourage the flock-master to expect a very bright future. It is now so plain that "he who runs may read" that the natural increase of the human family and the corresponding increase of value of the lands in the older countries of Europe preclude the possibility of producing cheap food for the millions. Therefore America must feed and clothe Europe, because ours is the only country where agriculture, guided by science, has vast and undeveloped fields, by the occupation of which her production can be multiplied many times by the amount necessary for home consumption, and at much less cost than they can be produced elsewhere. This leads us necessarily to the conclusion that the food and clothing industries of the United States are to be the great cornucopia from which is to be poured into her lap untold millions of wealth, and from whence shall spring the great source of supplies that is yet to ameliorate the condition of mankind.

OUR SWINE.

As our Tennessee farmers are necessarily keeping pace with the progress of the age, they have discarded the primitive, long-nosed animal plow, and introduced all of the improved breeds. After a comparative thorough test, based upon experience guided by the markets of the world, they have generally adopted the improved "Berkshire," or the grades with Berkshire base. Experience has taught us that no swine with white skins are adapted to southern latitudes. All of the white breeds are liable to skin diseases when exposed to the heat during our long, hot summers. This is owing to a physiological fact, the details of which are not germane to an article treating the breeds in so cursory a manner as this. The merits of the Berkshires are too generally known to undertake their repetition here. Since the abolition of slavery very large hogs are no longer in demand in the South, but rather an animal yielding a quick return for food consumed, and at the same time producing a tender and nicely marbled flesh. Such is the Berkshire; hence its general adoption throughout this State and farther south.

In view of the facts set forth briefly in this article, taken in connection with all the varied interests pertaining directly to the agriculture of our country, permit me to express the opinion that the Agricultural Department is the most important bureau in our Government, and the day is not far distant when it will be so recognized and regarded.

HORSE BREEDING FOR THE TURF, THE ROAD AND THE FARM.

By J. H. SANDERS, *Editor of the Breeders' Gazette, of Chicago, Ill.*

I am afraid that in what I shall have to offer upon this subject I shall not stick very closely to the text, for I am not much of a believer in the "horse of all work," or of universal adaptation. The text of our worthy Commissioner's invitation to discuss the horse at this meeting would seem to imply that there is now in existence, or may be created, some particular style or breed of horses best adapted to general use in the United States—such a horse as is often spoken of as "the horse of all work."

Now, while I am free to admit that a horse may be found that will perform a wide range of service reasonably well, yet it is undeniably true that strictly speaking there can be no such thing as the "general purpose" or "all work" horse. The best possible roadster would certainly make but a sorry show as a draft horse, and one that would carry off the blue ribbon in a good ring of horses for heavy draft, would not be the horse that any one of us would select for a fast or long drive on the road. The fact is that everybody, aside from the farmer, when he buys a horse, buys him for some especial use or purpose. One man buys for the street cars of a city; another buys for use on the road; a third purchases for the omnibus; still another selects with especial reference to use in the heavy drays and carts of our large cities or for the lumbering regions, while another wants a stylish high-stepping carriage horse. Each of these in purchasing selects the horse that in his judgment is best adapted to that use to which he is to be put; none want the "horse of all work." The horse is always selected *for a special use*, and in proportion as he is adapted to that purpose is he considered valuable by the purchaser.

Believing, therefore, as I do, that it is best for all farmers to breed with reference to especial adaptation to some pacticular use, I shall first direct my remarks to a consideration of some of the general principles which should guide the breeder of horses of any given type, and will then offer some general suggestions as to the breeding of some of the most profitable and useful types of American horses.

It is safe to assume that the intelligent gentlemen I am addressing to-day are sufficiently well informed in the general principles of breeding to understand that one "cannot gather grapes from thorns nor figs from thistles." The general principle that "like produces like" is true throughout all animal and vegetable life. Everything brings forth after its kind. We sow pure seed and expect the produce to be of the same kind. Wheat does not produce rye, neither will oats produce barley. The rule is just as true in animal life. The great principle that each begotten creature is but the sum or essence of what has preceded it, admits of very few exceptions. We have only to apply this general principle, with a knowledge of the special characteristics of the various breeds and families of horses, and the business of breeding horses of any given type becomes greatly simplified. No man would breed to a Shetland pony with the expectation of producing a draft-horse, nor to the ponderous draft-horse with the hope of the produce turning out a winner on the race-course. The general characteristics of the breed to which the parents belong will be transmitted to the progeny, and in proportion as the breed is firmly established and uniform in its characteristics, so will the produce be uniform in its character. Whatever

has been "bred in the bone" will be transmitted. A pair of Shetland ponies will produce a Shetland pony with unerring certainty, because in all the characteristics which distinguish the ponies from other breeds of the horse kind they are uniform, but we cannot count with certainty upon the color of the hair or the individual peculiarities in many minute details, because in these minor points uniformity in the race has never been established. But whatever has been firmly fixed as a characteristic of the breed, whether it be peculiarity of gait, form, color, size, disposition, or speed, will be transmitted with a certainty in proportion to the degree of uniformity which has been obtained in that particular in the ancestry.

I have often been struck by the heterogeneous character of the horse stock of our country, which is a conglomeration of every breed and type of the horse kind in the known world. Until very recently no intelligent effort had been made to keep any of the breeds pure except the thoroughbred. We have crossed in and out without rhyme or reason until, with the single exception of our thoroughbred horses, it is scarcely possible to trace the pedigree of any given animal four generations back without finding an admixture of all the various breeds and types that have ever been known. With such an ancestry it is not to be wondered at that disappointments meet the breeder on every hand. He selects a fine-looking bay mare that will weigh nearly 1,500 pounds in moderate flesh, clean-limbed and strong, and he looks about for a stallion possessing the same characteristics, that he may couple the two together to produce a first-class draft-horse. He has been told that "like produces like" so often that he believes it, and this theory leads him, very properly, to think that from such a pair his hopes of producing good draft-horses will be realized. But he is disappointed. The produce is not like either of the parents, and he pronounces breeding a lottery and the doctrine of the transmission of the peculiarities of the parents to the progeny a humbug. He forgets that heredity transmits with certainty only what has been firmly fixed in the ancestry, and he loses sight of the fact that his large, fine bay mare was herself the produce of a mixed ancestry—perhaps of a bay Clydesdale stallion and a little sorrel mare of unknown blood—and that his stallion was probably got by a half-blood French draft-horse out of a dun pacing mare, whose dam in turn was a Mexican mustang. The possession of the desired qualities in the sire and dam selected was an accidental circumstance, and the intelligent breeder, with a knowledge of this fact, would not expect that these accidental qualities would be transmitted with a certainty. The force of heredity is usually exerted to compel the progeny to adhere to the character that has become fixed in the species rather than to follow the variation from the established type that was accidental in the immediate ancestry; but when, through selection of both parents with reference to this particular for several generations, the influence of heredity has once been exhibited in the transmission of what was originally but an accidental variation, it always lends its powerful aid in favor of the perpetuation of the desired form.

In the application of these general laws which govern the transmission of hereditary qualities to the business of breeding horses, the first step is for the breeder to decide in his own mind what sort of horse he wishes to produce. If his fancy or interest leads him to breed horses for the race-course, his path will be a comparatively easy one, for he finds already created to his hand a breed that for two hundred years has been bred especially with that point in view. But even here, within the limits of this, the purest and best established of all our breeds of horses, he will find ample room for the exercise of a discriminating judgment in the choice of sires and dams. Here, as everywhere else, the motto must be, *breed from the best.* Select winners on the turf, great performers descended from great performers. Such has ever been the practice of the most successful breeders of race-horses, both in England and America.

Fifty years ago the American trotting horse, *as a breed*, was unthought of; and one that could trot a mile in less than three minutes was a wonderful animal. But the ability to trot fast was a desirable quality, and breeders sought to perpetuate it. Animals that excelled the average of the species as trotters were selected to breed from, with a view to perpetuating and intensifying this quality; but as its possession was at that time an accident, a spontaneous variation, it was found that but few of the immediate descendants of the animals first chosen with a view to breeding fast trotters could trot faster than their remote ancestors. But when such of them as did show improvement in this direction were again selected for breeding purposes, and coupled together, it was found that, while there were still many failures, the proportion of the descendants that showed improvement in the trotting gait beyond the average of their ancestors was materially increased. And so, by selecting from generation to generation from such families as have shown a tendency to improvement in this quality, we have made considerable progress toward founding a breed of trotting horses. So generally is the attention of the breeders of trotting horses directed to the "bright, particular star" in the trotting firmament, each year, that we lose sight of the immense numbers of horses that trot in 2.30 to 2.50—a gait that twenty, and even ten years ago, was fast enough to entitle a horse to rank as a creditable performer on the turf; and in our admiration for these great performers we have failed to note the

extent to which the *average* speed of the so-called trotting families has been improved. What horseman who has reached the age of forty years cannot remember how very rare three-minute trotters were when he was a boy! And yet, what a large proportion of our Hambletonians, Clays, Bashaws, and Mambrinos now trot faster than three minutes, and what an enormous number are now brought out each year that can trot a mile better than 2.30!

While much of this increase in the average speed of our trotting horses should in justice be attributed to improvement in our vehicles and tracks and to increased skill in the trainer, yet it is undeniable that by far the greater portion of it has resulted from increased capacity in our horses, bred for two, three, or four generations especially with reference to this quality; and it is worthy of especial remark that, of the nearly three hundred horses with records of 2.25 or better, whose breeding can be traced even as far as the sire, over 90 per cent. of them are more or less closely related to one or more of our recognized trotting families.

Hence, while chance trotters may occasionally be produced, as of yore through spontaneous variations, our breeders and trainers have found that by confining themselves to the descendants of three or four well-known trotting families the probabilities of producing fast trotters are infinitely greater than by going outside; for within these families the trotting gait has been cultivated by selection and use until heredity has begun to lend its powerful aid in transmitting what was originally a spontaneous or accidental superiority; and the breeder who introduces a single cross in which the trotting gait has not become an inherent quality only adds to the probabilities of failure and postpones the day when we shall be able to breed fast trotters with certainty. There is as yet no necessity for an outcross to promote strength, endurance and vigor; for some of our trotting families are in this respect the peers of any breed of horses in the world, and there is still sufficient room for selection within these families to correct all the bad effects of close inbreeding. But we have still much to do before we can claim to have established a breed of trotting horses; and the more closely we confine ourselves to judicious selections from the families that *trot* and *produce* trotters, the more rapid will be our progress in the formation of a breed in which superiority in the trotting gait shall be an inherent and transmissible quality.

It may possibly be necessary to resort to some crosses outside of these trotting families for improvement in some other quality, but there is no outcross that we can possibly make without danger to the transmission and improvement of the trotting gait. Even those of our trotters that belong to none of the recognized trotting families, are almost invariably the result of selection with a view to this faculty. In almost every case of "breeding unknown" we have found that the dam was a "fast trotter." In short, the more thoroughly we investigate the course of breeding that has produced our trotting horses the more completely does it confirm the theory of breeding from animals that possess the quality we wish to perpetuate.

"*How shall we breed the farmer's horse?*" is a question which may well begin to agitate the minds of farmers, especially throughout the States west of Pennsylvania. The tendency for years past on the part of farmers has been to breed for special uses, but none of these their *own*. One has been breeding for the running course, another has looked wholly for speed at the trotting gait, and still others (and perhaps the wisest of them all, because the more uniformly certain and profitable have been the results) have been breeding for heavy draft. But none of these types constitutes the farmer's horse *par excellence*. His horses must be strong enough to draw the plow, the farm wagon, the reaping and mowing machine, and active enough to draw him and his family comfortably on the road at the rate of six or eight miles an hour without banging themselves up. The farm horse must be pre-eminently one of courage and endurance; and the mythical legs of ivory, sinews of steel, and hoofs of iron are none too good for his necessities. He must be hardy, energetic, and docile. The lazy, dull, sluggish horse is a nuisance on the farm; if he has a fitting place anywhere in the economy of nature, it is in the cities, harnessed to the ponderous drays and truck wagons, where a gait faster than two miles an hour would be unorthodox. One instinctively associates this gait with ponderous weight in the horse, a ponderous load behind him, and a smooth, level street for his work. But on the farm, where rows of corn are to be plowed and the team must about face or wheel to the left every five, ten, or fifteen minutes, one does not care to have his patience tried with a horse that cannot turn around more than three or four times between breakfast and dinner time, or that cannot step off briskly over the soft, plowed ground, or up and down the hillside. Neither does he want one so light of body and of limb that the constant draft of the plow or the reaping machine will soon break him down through sheer weight, or so mettlesome that he will tug on the bit, and fret and prance all day until he and the driver are both worn out.

But there is a happy mean—a horse that will weigh from 1,100 pounds to 1,200 pounds, and about 15½ to 16 hands high, good tempered, active, docile, intelligent, quick of motion, sure of foot, and easily taught; such is the horse best adapted to the varied use of the farm. Not so high-priced on the market as the 2.20 trotter or

the handsome, stylish carriage horse; not reared with anything like the certainty as where 1,600 to 1,800 pounds' weight is the sole end and aim of the breeder's effort, but much better and worth much more money *to the farmer* than either of these *if he wants him for his own use.* How can he breed such horses? With such mares as are now owned by a large proportion of the farmers throughout the Western States, he need not concern himself much about the size, they will be big enough to fill the requirements, because the thousands of Percheron, Normans and Clydesdales, and English cart-horses that have been imported within the past twenty years, have graded up the stock, so far as size is concerned, until the size best adapted to the farmer's use is quite as easily exceeded as otherwise. If we were to continue to use stallions of these imported strains, let our choice rest upon the smaller, more compact, quick, active, spirited ones among them, because, as a rule, they are too sluggish, too coarse, too dull, and too heavy for the farmer's own use, however well they may *sell* and however well they may be adapted to some other purposes. But in our opinion, more certain results will be attained from the use of our own highly bred strains of roadster and thoroughbred stallions upon these large half and three-quarter draft mares. A strong, sound, well-muscled, intelligent, quick-gaited horse, with two or three good trotting crosses, such as Hambletonian, Mambrino Chief, Vermont Black Hawk, or Clay, built upon a genuine thoroughbred foundation, not a "said to be," but good old Lexington, or Glencoe, or Sir Archy, or Grey Eagle, or Medley, or American Eclipse stock, and you have something that, for the farmer's use, is as good as gold. And we are not sure that with our coarse, cold-blooded draft mares it will not in most cases be quite as well, or even better, to let the top trotting crosses go, and take a large, strong, compact, sensible, business-like thoroughbred sire to begin with. The great trouble with the majority of thoroughbreds is temper; they are, as a rule, too high-strung and mettlesome for good *work* horses. But our draft mares, on the other hand, are too idiotic, and dull, and sluggish, and soft, and flat-footed, and coarse-grained to be well adapted to farm work, and so by blending the two types together for a few generations we may succeed in eliminating the bad and retaining the valuable features of both, and so produce *the model farmer's horse.*

CATTLE INDUSTRIES.

By J. B. Grinnell.

The following propositions were to have been elaborated by me in a paper which, but for sickness, would have been presented at the gathering of stock men at Washington in Convention.

My first proposition is that there has been an enormous increase in consumption of beef in the United States during the last quarter of a century, evidenced, firstly, by the greater ratio of increase of cattle than of population; secondly, by the statistics of beeves shipped to nine railway points, being 2,010,000 head in 1871, and 4,311,000 in 1881, the arrivals in Chicago having increased in the last decade from 543,000 to 1,547,000, about 350 per cent.; and thirdly, by an increase in weight through better breeding, higher feeding in the corn States, and less shrinkage by freighting than by former driving in the new West, fully equal to 10 per cent.

My second proposition is *that there is to be a still greater increase of beef consumption* Vegetarians and "bran-bread" advocates have yielded to the universal opinion that a plentiful supply of good beef to a nation means increase in vigor, health and strength. No nation can compete with ours in furnishing Great Britain with the best beef and at reasonable prices.

My third proposition is that the cattle-breeding sections in the lower latitudes, and at the Northwest under the climatic influences of the Pacific coast, taken with the rich northern grasses, afford great attractions to the cattle industry. Cheap railway transportation encourages breeding for loin rather than legs for locomotion. The utilization of water and its application by art to the soil, is giving value to hundreds of millions acres of land deemed hitherto worthless.

This will promote the study of the adaptation of breeds to the various localities relating to hardihood, prolific breeding and breeding for the shambles; also the sources of supply for breeding stock and the demands of steer-feeders in the corn States.

The fourth proposition is, that there is demand for the refrigerator system on the railways for beef shipment from the distant West; this on the ground of saving to the shipper 10 per cent. in freight, the meat being less than on the living animal and 20 per cent. in freight on the worthless offal. The average shrinkage of the live animal in transit equals 10 per cent., and the gain to the consumer, by reason of the meat being unbruised and free from fevers incident to hunger, thirst and uneasiness in a transit of from six to ten days, must be added to the increased consumption which follows a cheapening of cost to the masses.

These propositions, while quite radical, are practical enough to elicit discussion and invite investigation.

THE VALUE OF THE GUENON SYSTEM.

By GEORGE BLIGHT, *of Philadelphia, Pa.*

How to select cows for milking, bulls for breeding, and steers for fattening. forms the subject of this article.

COWS.

For more than twenty years my attention has been called to the dairy interests of our country. During that period many hundred animals have been carefully examined, all their good and bad points noted and deductions drawn, which time and experience have taught me to consider to be most correct, affording valuable knowledge to those engaged in dairy business or in handling cattle for beef.

Guenon work has formed the basis of my investigations. By constant study and appreciation of this system, perfect knowledge of the cow can be acquired and the yield of her milk ascertained, and seldom have I failed to portray her true character, whether she be a milker or no.

In my mind there is no doubt those external marks do indicate the value of the animal, and by them her power of yielding 12 pounds, 8 pounds, or 4 pounds of butter per week. Is not this of great value to the farmer? The cow producing 12 pounds will consume little more food than the one giving her owner but 4 pounds.

One charm possessed by this system of judging dairy cows is, that it militates against no preconceived views; it only adds to the powers of selection. In fact, the cow with the fine escutcheon possesses all the old-fashioned qualifications; she will be found to have the long neck, free from coarse hair, small hind legs, with horns turned in or downwards, not up.

BULLS.

The bull should possess all points required for perfection. These are seldom found in one animal; but my advice to the breeder is not to stop until he gets the right animal, for everything depends upon the excellency of the bull. I have known the progeny of a whole herd rendered of little value by the use of bulls not properly marked according to the Guenon system, and when a change has been made, heifers from the same cows have improved in productivenss. Is not this a matter of deep importance to the dairyman, and enough to induce him to study the system closely until he has thoroughly mastered the subject?

STEERS, OR FATTENING CATTLE.

The commonly received view is, that all castrated animals make good beef. It is true they will "make beef," but those animals selected by the Guenon marks will fatten more easily on the same amount of food, and will put the fat on those parts of the body most valuable, whereas those badly marked will become large and coarse on the shoulders, and heavy in the horn parts which command the lowest price in the market. Is not this of great value to the farmer before he purchases or stables his ox?

In the bovine race there are other marks not mentioned by Guenon which experience has taught me to be of value, such as the position of the swirl on the back. To many this may sound strange and riduculous, but to me it indicates the center of the veins in the animal. In the cow, when found toward the middle of the back, it indicates that the nourishment the animal receives goes towards the udder; when this swirl is in the shoulder, that it goes to the shoulders, head and horns—unproductive parts.

In the steer, when the swirl is in the middle of the back, the food the animal receives goes to the ribs and hindquarters; but when on the shoulder, the forequarters and horns receive the benefit of the corn fed to him. Let me assure the Convention there is much advantage in learning how to apply this knowledge.

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